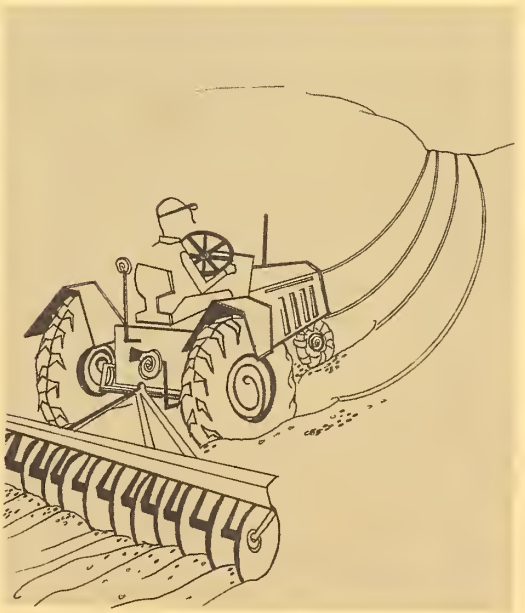
CHANGES IN

AGRICULTURE IN 26 DEVELOPING NATIONS

1948 TO 1963



FOREIGN AGRICULTURAL ECONOMIC REPORT NO. 27
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CONTENTS

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PREFACE

This publication deals with the performance of agriculture in the economy of 26 developing nations. It reports the major findings of the first or comparative phase of a research project entitled "Factors Associated with Differences and Changes in Agricultural Production in Underdeveloped Countries". This research is being conducted by the Economic Development Branch, Foreign Development and Trade Division, Economic Research Service, (ERS) of the U.S. Department of Agriculture for the Agency for International Development (AID), under an agreement entered into in March 1963.

This report has been prepared by a team of 11 people all of whom have drawn heavily upon the work of each other in developing their respective assignments. William E. Hendrix, as leader of this team, had responsibility for developing work plans, directing work activities, and making final revisions in all chapters. Chapters of this report and authors primarily responsible for them are as follows:

Chapter 1.--General Overview of Study--William E. Hendrix
Chapter 2.--Sources of Change in Crop Output--William E. Hendrix
Chapter 3.--Land and Other Natural Features--Steven A. Breth
Chapter 4.--Land Tenure and Size of Holdings--Jiryis Oweis
Chapter 5.--Technology--Donald D. Steward
Chapter 6.--The Human Factor--Jane R. Turns (pp. 62-74), David Nicholls (pp. 75-76)
Chapter 7.--Capital and Credit--Dwight Gadsby
Chapter 8.--Demand and Prices--Harold T. Yee
Chapter 9.--Marketing Facilities and Practices--Clarence A. Moore
Chapter 10.--Agriculture in the Economy of Underdeveloped Countries--C. A. Moore
Chapter 11.--Conclusions--William E. Hendrix
Appendix I.--An Illustration of Uses of this Publication in Agricultural Development Planning--William E. Hendrix

Margarite Settle and Helen Clifton obtained reference sources, compiled data, and assisted with the statistical work.

The research staff for this report benefited from the information, suggestions, and criticisms of many experts in agencies of the Department of Agriculture, other U.S. departments, international agencies, universities, and foundations. None of these experts or the agencies they represent, however, were responsible for interpretations of the information provided. One of these agencies was the Food and Agriculture Organization of the United Nations (FAO), which cooperated with ERS in this study under an ERS-FAO contract from June 1963 through December 1964. Under this agreement, FAO made available to ERS its regularly published reports, plus information not heretofore available. This material included special tabulations made from past survey records and new information obtained through questionnaires and field visits by FAO personnel in FAO member countries.

Data on crop areas and output were developed specifically for this project by the Foreign Regional Analysis Division, under the technical direction of Charles A. Gibbons.

At all stages in this study, ERS personnel obtained extensive advice and information from Dr. Frank W. Parker and Dr. Erven J. Long, Deputy Director and Director, respectively, Agricultural Service, Technical Cooperation and Research, AID. Valuable assistance in developing study plans, choosing study countries, and planning country visits for research personnel was provided by members of an AID Advisory Committee. This committee initially consisted of Frank W. Parker, Chairman, C. L. Orrben, Monroe McCown, W. S. Middough, Lyle Peterson, and Alan M. Strout. An ERS Technical Advisory Committee

reviewed and made important recommendations on work plans and on early drafts of this report. This committee was composed of the following:

Dr. Sherman E. Johnson, Chairman, Deputy Administrator, Economic Research Service, U.S. Department of Agriculture.
Dr. Max Millikan, Director, Economic Development Center, Massachusetts Institute of Technology.
Dr. Kenneth L. Turk, Director of International Agricultural Development, Center for International Studies, Cornell University.
Dr. Gustav Ranis, Associate Director, Economic Growth Center, Yale University.
Dr. William W. Lockwood, Woodrow Wilson School of Public and International Affairs, Princeton University.
Dr. Sherwood O. Berg, Dean of Agriculture, University of Minnesota.
Dr. E. T. York, Provost for Agriculture, University of Florida.
Dr. John Provinse, retired, formerly sociologist and cultural anthropologist with Council on Economic and Cultural Affairs.
Dr. Frank W. Parker, Deputy Director, Agricultural Service, Office of Human Resources and Social Development, AID.

Additional personnel in the Department of Agriculture who counselled on work plans and early drafts of the report include Willard W. Cochrane, formerly Director of Agricultural Economics; Nathan M. Koffsky, Director of Agricultural Economics; Matthew Drosdoff, Administrator, and Gerald E. Tichenor, Deputy Administrator, International Agricultural Development Service; Wilhelm Anderson, Director, and Quentin M. West, Deputy Director, Foreign Regional Analysis Division, ERS.

Finally, special acknowledgements go to Wade F. Gregory, Chief, Economic Development Branch, Foreign Development and Trade Division, ERS, who has offered many helpful suggestions on the study; to Raymond P. Christensen, Deputy Director, Foreign Development and Trade Division, ERS, who helped to develop the participating agency agreement under which this research was done, to staff the project, and to advise on work plans; and to Kenneth L. Bachman, Director, Foreign Development and Trade Division, who has frequently consulted with the project staff and provided counsel on many facets of the study.

SUMMARY

The agricultural problems of 26 developing nations are considered; 7 of these countries are in Latin America, 4 in Africa, 4 in Europe, 7 in the Near East and South Asia, and 4 in the Far East.

Objectives of this report were to show levels and changes since 1948 in agricultural output and productivity in these countries and to identify and assess roles of major physical, economic, and social factors associated with differences in these levels and changes.

Between 1948 and 1963, 12 of the 26 developing nations had compounded rates of increase in crop output of more than 4 percent per year. These rates surpassed those ever achieved by now economically advanced nations during comparable periods of time. The 12 countries were: Sudan, Mexico, Costa Rica, the Philippines, Tanganyika, Yugoslavia, Taiwan, Turkey, Venezuela, Thailand, Brazil, and Israel.

From 1948 to 1963, rates of increase in crop output failed to exceed population growth rates in only 5 of the 26 countries--Nigeria, Egypt, Pakistan, Tunisia, and Jordan. From 1955 to 1963, Tunisia and Jordan alone had greater increases in population than in crop output.

Most of the 26 countries need to increase their agricultural production at even faster rates to facilitate achievement of their national development objectives. Faster production rates will supply the foreign exchange earnings which developing industrial sectors and related urban complexes need in excess of their own foreign exchange earning capacities.

The successes of the 12 leading countries in increasing their agricultural output enhance the possibility that underdeveloped countries generally can increase their per capita production of foods and fibers in the near future.

The 12 countries differ largely in many of the factors which influence their agricultural production potentials: in climate; rate of illiteracy; supply of land resources; cultural pattern; and governmental system.

As a source of change in crop output, increases in the area of crops were more important than yield increases in 45 percent of the countries while yield increases were more important in 55 percent.

Arable land expansion potentials are relatively large in much of South America and Central Africa, but are very limited in densely populated Asian countries.

Within appreciable limits, land, labor, improved seeds, fertilizers, improved human skills, improved forms of organization, and other such factors can be substituted for each other in agricultural production. Such substitution possibilities enhance the opportunities and help to simplify the task of increasing agricultural output and productivity in the world's less-developed countries. For example, Sudan, which has one of the highest levels of illiteracy in the world, has achieved a very rapid rate of increase in agricultural production since 1948 through management supervision or special programs of organization and technical assistance.

The factors associated with differences in rates of increase in agricultural output among the 26 countries form a rational, but highly variable, pattern that is somewhat in accord with the uniqueness of each country in its combination of human, land and capital resources, and technical possibilities, and in its institutional, social, and political features.

Rapid rates of increase in crop output have not happened just as a consequence of normal economic and social processes in societies organized on a laissez-faire basis. Rather, they have been undergirded by aggressive group action, generally national in scope, directed specifically to improving agricultural production conditions.

CHANGES IN AGRICULTURE IN 26 DEVELOPING NATIONS, 1948 to 1963

Foreign Development and Trade Division
Economic Research Service

CHAPTER 1.--GENERAL OVERVIEW OF STUDY

Objectives, Scope, and Methods of Study

The main objectives of this study were (1) to measure levels and changes since 1948 in the agricultural output and productivity of less-developed countries, and (2) to identify and assess the roles of the major natural, technological, economic, social, and institutional factors associated with differences in these performance patterns.

The report is based mainly upon information compiled for 26 countries selected to represent major low-income regions of the world. This information was for the most part developed from secondary sources; these included published and unpublished reports, and working files of cooperating national and international agencies. Supplementary information was obtained through brief visits to several of the countries and through interviews in the United States with experts on these countries.

The 26 study countries are Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, and Venezuela in Latin America; Nigeria and Tanganyika (as constituted in 1962) in Central Africa; the United Arab Republic (Egypt), Sudan, and Tunisia in North Africa; Jordan, Israel, Greece, Turkey, Iran, Pakistan, and India in the Near East and South Asia; Thailand, the Philippines, Taiwan, and Japan in the Far East; and Yugoslavia, Poland, and Spain in Central and Western Europe. These countries represent an appreciable part of the total program responsibilities of the Agency for International Development: they now represent approximately 75 percent of the total population, 73 percent of the gross national product, and 73 percent of the AID budget in all AID-assisted countries.

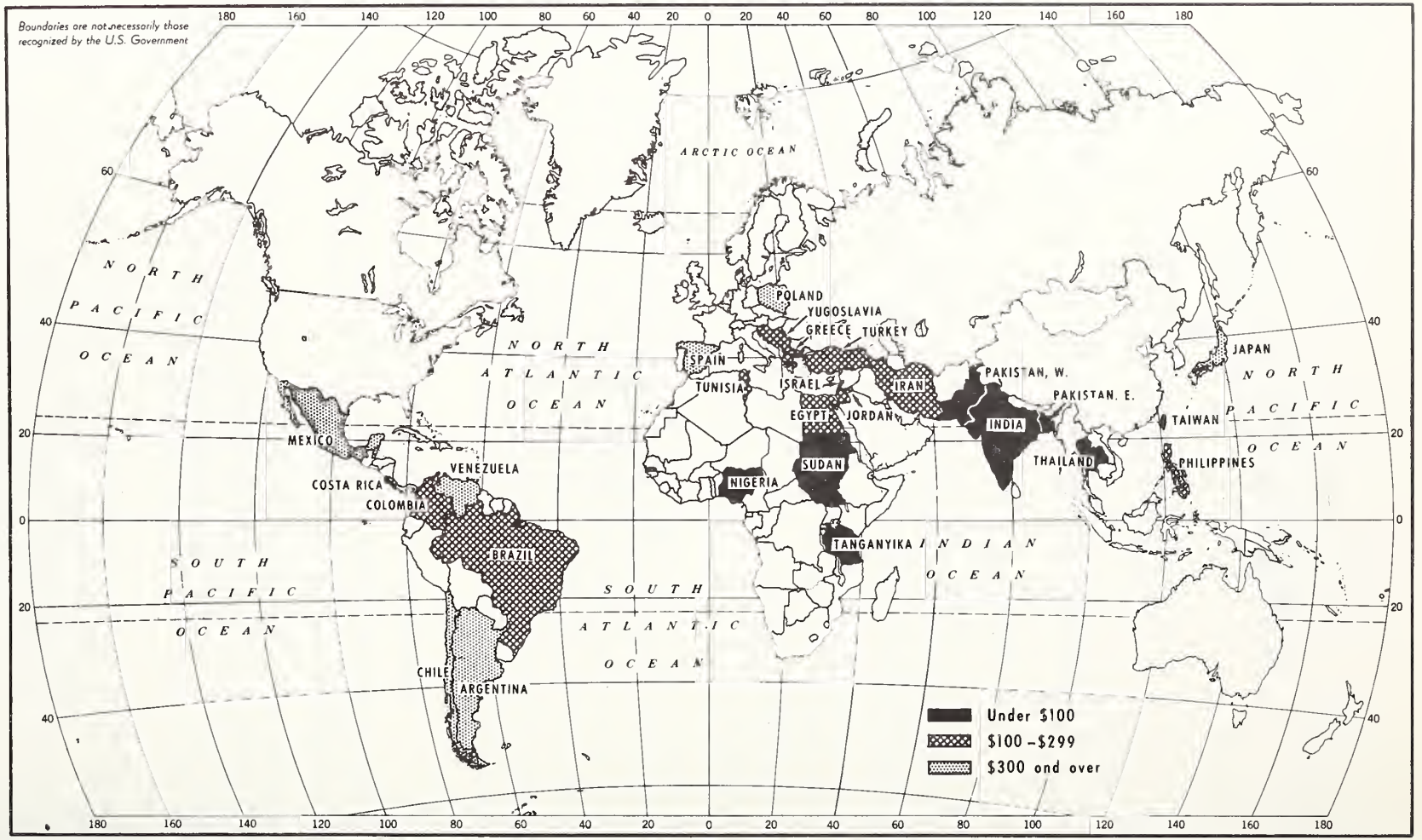
Some General Attributes of the Study Countries

The 26 study countries exhibit large differences in their natural features, historical backgrounds, demographic and cultural features, institutions, and levels and patterns of agricultural and general economic development.

Twelve of the 26 countries lie wholly, or in large part, between the latitudes of 30 degrees north and 30 degrees south of the equator; 12 lie beyond these tropical and semi-tropical ranges; and the land area of 2 is about equally divided between these major climatic zones (fig. 1). Six of the countries lie in mainly semi-arid and desert regions. Most of the others have considerable rainfall, although a few also have semi-arid and desert areas.

Ten of the 26 countries are European or have large populations of European descent. Several nations date back into antiquity and some have made large contributions to the development of civilization through literature, art, mathematics, government, and religious and philosophical thought. Others have only a short history as a nation and have not yet made substantial cultural contributions. Three of the world's four major racial groups and several of the world's major religions exist within one or more of the countries studied.

PER CAPITA GNP, 26 COUNTRIES, 1958



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NEG. ERS 3441-65(1) ECONOMIC RESEARCH SERVICE

Figure 1

In their governmental systems, the countries range from democratic and semidemocratic to authoritarian forms. Several have long been under colonial rule, while others have been independent nations for a century or more.

In their levels of economic development, most of these countries lie in the lower half of the world's distribution. Six of the countries--Tanganyika, Pakistan, Sudan, India, Thailand, and Taiwan--still have a per capita gross domestic value of production in U.S. dollars of less than $100. Eight of the countries have a per capita gross domestic product of $300 or more (fig. 1). These are Argentina, Chile, Venezuela, Mexico, Spain, Poland, Israel, and Japan. Of these countries, Israel, Venezuela, and Japan have recently exhibited very rapid economic growth. Venezuela's growth is based largely upon its mineral resources. The economy of the other three countries, especially of Argentina and Chile, has been relatively stagnant for two to three decades. Japan has become a modern industrial nation, exhibiting a long-sustained and a high rate of general economic growth.

Agriculture is the major occupation of more than half of the total labor force in 16 of the 26 countries and of more than three-fourths of the labor force in 7 countries (Chapter 6, table 40). It accounts for less than a proportionate share of the national income as a result of farm-nonfarm disparities in per capita incomes. Even so, agriculture is the most important industry in all of the study countries and accounts for more than a third of the gross national (or domestic) product in 19 of the 26 countries.

Why Improving Agriculture is Needed

Some progress has been made during the past decade toward closing the gap between world food needs and food consumption. Even so, food consumption levels, based upon daily per capita intake of calories, are below desirable levels in 11 of the 26 study countries. These 11 countries are Colombia, Sudan, Tunisia, Egypt, Tanganyika, Iran, Jordan, India, Pakistan, the Philippines, and Thailand (table 1). Because food supplies are unevenly distributed, most of the other countries have large population groups which suffer from both undernutrition and malnutrition.

These food deficits are of great magnitude. For example, if present food supplies of India were distributed as far as they would go at the rate of 2,300 calories per person per day, 48 million out of that country's 480 million people would be left totally without food. If these same food supplies were distributed at the U.S. consumption rate of 3,190 calories per person per day, 153 million of India's people would be without food.

Table 1.--Food consumption per person per day and food consumption deficits in 26 study countries, United States, and Netherlands, 1959-61

Region and country	Food consumption per person per day	Food consumption deficit per person per day	Region and country	Food consumption per person per day	Food consumption deficit per person per day
	Calories	Calories		Calories	Calories
Latin America			Near East and So. Asia		
Argentina	3,220	0	UAR	2,300	200
Brazil	2,710	0	India	2,060	240
Chile	2,610	0	Iran	2,120	330
Colombia	2,280	220	Israel	2,840	0
Costa Rica	2,520	0	Jordan	2,200	250
Mexico	2,580	0	Pakistan	2,120	180
Venezuela	2,330	170	Turkey	2,590	0
Africa					
Nigeria	2,450	0	Far East		
Sudan	2,160	186	Japan	2,360	0
Tanganyika	2,440	20	Philippines	2,000	350
Tunisia	1,900	450	Taiwan	2,440	0
			Thailand	2,120	230
Europe					
Greece	2,960	0			
Poland	3,100	0	United States	3,190	0
Spain	2,740	0	Netherlands	3,000	0
Yugoslavia	2,900	0			

Source: The World Food Budget, 1970, Foreign Agricultural Economic Report 19, ERS, USDA, Oct. 1964.

Food requirements are increasing as a result of population growth (table 2, column 1). At present growth rates, most of the study countries will double their population in about 25 to 35 years. If they succeed merely in increasing food production at rates equal to their population growth rates and if there is no change in their import-export ratios, these countries will also have twice as many hungry people during this time span. It is unlikely that an increase in agricultural output alone will in the long run reduce world hunger. Rather, the Malthusian specter of population growth outrunning food production is already a very real problem in many of the world's less-developed countries. Within a century, world population of 3 billion people would increase to 23 billion, at an annual compound rate of growth of 2 percent, and to 36 billion, at a rate of 2.5 percent a year.

Population growth the world over is now associated with increases in the percentage of total population living in urban centers. Hence, with the passage of time, each agricultural worker has to produce foods and fibers for an increasing number of people. Moreover, rising per capita income, especially in urban areas, is increasing per capita demand for food in most of the world's less-developed countries. Consequently, for the first time in its history, India's food shortage is not the result of crop failures and declining per capita food output, but of the increased capacity of its people to buy the food they need.

If predominantly agrarian countries continually fail to meet increased food demand, their general economic growth will likely be curtailed. This economic retardation can come about (a) through curtailment of their exports, now composed mainly of agricultural

Table 2.--Annual rate of change in population growth, per capita income, and domestic food demand, 26 study countries, 1950-60

Region and country	Annual population growth rate[1]	Annual increase in real per capita income[2]	Coefficient of income elasticity of demand[3]	Annual increase in food demand per capita	Total annual demand increases	Percentage of annual demand increase accounted for by population growth
	(1)	(2)	(3)	(4)	(5)	(6)
	Percent	Percent	Percent	Percent	Percent	Percent
Latin America						
Argentina	1.7	-0.1	0.17	-0.02	1.68	101
Brazil	3.1	2.6	0.51	1.33	4.43	70
Chile	2.5	0.9	0.61	0.55	3.05	82
Colombia	2.2	2.3	0.55	1.26	3.46	64
Costa Rica	3.9	3.7	0.60	2.22	6.12	64
Mexico	3.1	1.9	0.58	1.10	4.20	74
Venezuela	4.0	3.6	0.61	2.20	6.20	65
Africa						
Nigeria	3.7	1.9	0.64	1.22	4.92	75
Sudan	3.4	0.8	0.64	0.51	3.91	87
Tanganyika	1.8	1.1	0.64	0.70	2.50	72
Tunisia	1.8	1.7	0.65	1.10	2.90	62
Europe						
Greece	1.0	4.7	0.49	2.30	3.30	30
Poland	1.8	6.0	0.55	3.30	5.10	35
Spain	0.8	3.9	0.56	2.18	2.98	27
Yugoslavia	1.1	8.9	0.59	5.25	6.35	17
Near East and South Asia						
UAR	2.4	2.5	0.65	1.62	4.02	60
India	2.0	1.7	0.80	1.36	3.36	60
Iran	2.2	0.05	0.79	0.04	2.24	98
Israel	5.2	2.5	0.55	1.38	6.58	79
Jordan	2.6	1.7	0.65	1.10	3.70	70
Pakistan	2.2	0.3	0.80	0.24	2.44	90
Turkey	2.9	3.2	0.49	1.57	4.47	65
Far East						
Japan	1.2	7.6	0.58	4.41	5.61	21
Philippines	3.2	1.7	0.75	1.28	4.48	71
Taiwan	3.4	3.7	0.63	2.33	5.73	59
Thailand	3.2	2.4	0.72	1.73	4.93	65

[1] From U.N. (55), Series K, No. 2, table 1, pp. 22-30, except for Israel, which is from Y. Mundlak, Long-Term Projections of Supply and Demand for Agricultural Products in Israel, p. 203, Falk Project for Economic Research in Israel, Jerusalem, May 1964.
[2] (55), pp. 566-568.
[3] Agricultural Commodities, Projections for 1970, FAO, Rome, Italy, 1963.

products, (b) through diversion of an increasing part of their foreign exchange earnings from imports of needed capital goods to imports of food goods in greater demand, and (c) through the effects of increasing food prices on labor costs in industry and on size of income available for buying nonfarm goods and services.

At present population and income growth rates, the demand for food in most (16) of the study countries is increasing at annual compound rates of 4 to 6 percent a year (table 2). Most of this increase results from population growth (table 2, column 6). The European countries and Japan can buy much of their needed food with foreign exchange earned by industrial exports, and therefore do not require high rates of increase in agricultural output. Underdeveloped, predominantly agrarian countries, however, are not able to meet increased needs in this way.

Recent Trends in Agricultural Output

To appraise agriculture's recent contributions to the above development needs, an attempt has been made to develop indices of crop production in the 26 study countries (table 3). These indices are based upon a more comprehensive coverage of commodities and employ more uniform methods from country to country than previous indices did.

Table 3.--Total crop production: Index numbers for selected countries, 1948-63 (1957-59 = 100)[1]

Country and region	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
	Percent															
Latin America																
Argentina	81	75	72	64	87	88	92	80	99	88	107	105	93	105	103	113
Brazil	68	68	74	73	73	77	81	87	82	93	96	111	107	117	114	[2] NA
Chile[3]	80	77	69	73	76	83	83	90	90	87	105	99	102	103	100	109
Colombia	78	88	79	82	96	93	97	93	88	87	102	110	115	109	117	NA
Costa Rica	49	58	69	71	90	77	86	73	75	94	103	101	118	117	121	NA
Mexico	48	54	60	62	61	67	80	89	87	94	107	99	106	109	119	119
Venezuela	68	72	69	77	85	95	84	94	104	103	99	98	118	119	136	NA
Africa																
Nigeria	NA	NA	NA	NA	86	88	89	94	94	98	100	102	112	109	115	117
Sudan	42	50	58	54	62	69	75	90	105	76	105	119	104	157	130	125
Tanganyika	55	55	64	67	74	65	76	87	90	92	99	109	106	99	108	114
Tunisia	56	111	68	56	86	93	86	57	95	82	126	93	113	54	72	110
Europe																
Greece	54	81	60	76	65	90	81	85	88	106	93	101	86	109	96	NA
Poland	[4] 77	81	90	77	80	83	90	86	97	99	101	100	112	123	107	119
Spain	70	72	72	100	94	85	96	88	89	96	98	107	99	103	NA	NA
Yugoslavia	NA	NA	52	77	49	82	65	81	62	102	80	118	103	98	97	104
Near East and So. Asia																
UAR	84	82	79	76	84	80	92	89	90	98	98	104	108	89	117	119
India	80	75	80	76	78	82	93	95	94	99	93	108	105	115	116	113
Iran	63	71	78	70	78	84	85	83	87	99	99	102	97	105	102	117
Israel	32	31	42	41	50	72	73	73	85	89	105	106	88	106	120	124
Pakistan	86	94	90	96	89	91	99	96	93	102	99	99	106	111	117	116
Turkey	58	53	63	77	87	99	83	88	94	95	103	102	106	104	108	119
Jordan[3]	NA	NA	NA	NA	137	75	146	78	160	142	63	95	75	136	114	74
Far East																
Japan	76	74	79	78	85	73	80	101	94	97	99	104	108	106	108	103
Philippines	55	60	63	73	75	83	90	92	94	97	99	104	108	107	120	127
Taiwan	56	66	72	72	77	84	85	84	91	96	102	102	103	105	NA	NA
Thailand	72	73	79	87	81	96	81	97	109	90	102	108	129	131	136	NA

[1] Includes tree crops and all other except forage crops. [2] NA indicates data not available. [3] Field crops only.
[4] Does not include fruit.

Sources: Official country data, reports of U.S. agricultural attaches, and other sources by Foreign Regional Analysis Division, ERS.

Indices which reflect change in the production of livestock and livestock products as well as crops would be desirable, but were not practicable for this study because of (1) the lack of reliable estimates, and (2) the difficulties, with available statistics, of making adjustments needed to take account of feed grain imports and of feed grain transfers from the crop to the livestock economy.[1] In most of the study countries, however, livestock and livestock products account for relatively small parts of total agricultural production.

[1] Livestock indices for several of these countries are now being calculated.

Exceptions include Argentina, Chile, Poland, Yugoslavia, Greece, and possibly Japan. Livestock has become increasingly important in recent years in Japan. This increase, however, is based on large feed grain imports, and so does not represent a net addition of equal size to Japan's agricultural production.

Annual Compound Rates of Change in Crop Output

The indices shown in table 3 provided the basis for computing recent rates of increase in crop production as shown in table 4. In table 4, the countries are arbitrarily divided into two groups on the basis of the rate of increase in crop output between 1948 and 1963. In making this distinction, it is recognized that at higher levels of general economic development, progress in agriculture may be reflected more by transfer of resources from farm to nonfarm production than by increases in agricultural output. It is also true that for some countries more recent rates of increase in crop output differ markedly from those for the full period 1948-63.

During the period 1948-63, the rate of increase in crop production, computed on an annual compound basis, exceeded 5 percent a year in 7 of the 26 countries--Israel, Sudan,

Table 4.--Annual percentage rates of change in crop output, 26 countries, 1948-63, 1948-55, and 1955-63

Country	1948-63			1948-55		1955-63		
	Annual compound change in total crop output	Population growth rate[1] 1950-60	Annual compound change in crop output per capita[2]	Annual compound change in crop crop output	Annual compound change in crop output per capita[2]	Annual compound change in total crop output	Current population growth rate[3]	Annual compound change in crop output per capita[4]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Group I	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Israel	9.7	5.2	4.3	15.9	10.7	5.7	3.5	2.1
Sudan	8.0	3.4	4.4	10.2	6.8	5.8	2.8	2.3
Mexico	6.3	3.1	3.1	8.5	5.4	4.1	3.1	1.0
Costa Rica	5.6	3.9	1.2	4.6	0.7	7.9	4.1	3.7
Philippines	5.2	3.2	1.9	8.1	4.9	3.2	3.2	0.0
Tanganyika	5.2	1.8	3.3	6.4	4.6	3.1	1.8	1.3
Yugoslavia	5.1	1.1	4.0	6.1	5.0	4.3	1.1	3.2
Taiwan	4.5	3.4	1.1	5.4	2.0	3.6	2.9	0.7
Turkey	4.5	2.9	1.6	6.0	3.1	3.1	2.9	0.2
Venezuela	4.5	4.0	0.5	5.0	1.0	4.4	3.4	1.0
Thailand	4.4	3.2	1.2	3.9	0.7	5.4	3.4	1.1
Brazil	4.2	3.1	1.1	3.7	0.6	5.2	3.1	2.0
Greece	3.7	1.0	2.7	5.7	4.7	1.7	0.9	0.8
Average	5.5	3.0	2.3	6.9	3.9	4.5	2.8	1.5
Group II								
Iran	3.6	2.2	1.4	3.8	1.6	3.3	2.5	0.8
India	3.1	2.0	1.1	3.2	1.2	3.0	2.4	0.6
Poland	3.0	1.8	1.2	2.4	0.6	3.6	1.8	1.8
Agrentina	2.8	1.7	1.1	2.7	1.0	2.9	1.7	1.2
Chile	2.8	2.5	0.3	3.0	0.5	2.3	2.3	0.0
Japan	2.8	1.2	1.6	4.3	2.1	1.3	1.0	0.3
Spain	2.7	0.8	1.9	2.5	1.7	2.9	0.8	2.1
Colombia	2.6	2.2	0.4	1.5	-0.7	4.3	2.9	1.4
Nigeria	2.6	3.7	-1.1	2.6	-1.1	2.6	2.0	0.6
UAR	2.0	2.0	-0.4	0.7	-1.7	2.8	2.5	0.3
Pakistan	1.8	2.2	-0.4	-0.1	-2.3	2.8	2.2	0.6
Tunisia	1.6	1.8	-0.2	1.8	0.0	1.4	2.1	-0.7
Jordan	-1.9	2.6	-4.4	-2.2	-4.5	-1.9	2.7	-4.3
Average	2.3	2.1	0.2	2.0	-0.1	2.4	2.1	0.4

[1] Same as footnote 1, table 2.
[2] Assumes 1950-60 population growth rates.
[3] Based on U. N. Demographic Yearbook.
[4] Assumes current population growth rates.

Mexico, Costa Rica, the Philippines, Tanganyika, and Yugoslavia. It varied from 4 to 5 percent a year in 5 other countries--Taiwan, Turkey, Venezuela, Thailand, and Brazil.

Per Capita Changes in Crop Output

Over the 1948-63 period, output per capita of total population increased in 21 of the 26 study countries. Six of these countries--Israel, Sudan, Mexico, Tanganyika, Yugoslavia, and Greece--had per capita increases of 2 percent or more a year (table 4). Agricultural output per capita of total population declined during this period in Nigeria, Egypt, Pakistan, Tunisia, and Jordan.

As shown in figures 2 through 5, rates of increase in crop output relative to rates of population growth have fluctuated widely from year to year in several of the study countries. Also, for most of the countries, rates of crop output growth for 1948-55 differed substantially from rates in 1955-63. Sixteen of the 26 countries had higher rates of increase in their crop production in the earlier than in the latter period; 9 had higher rates in the latter period than in the earlier one; and 1 had the same rate. Countries with higher rates of increase during 1955-63 include Costa Rica, Thailand, Poland, Argentina, Spain, Colombia, Egypt, and Pakistan. Because of increases in total crop output and a decline in population growth rates, 11 of the 26 countries had a higher per capita rate of increase in their agricultural output in the 1955-63 than in the 1948-55 period.

In general, countries that had the highest rates of increase in 1948-55 had decreased rates in the latter period. Conversely, countries that had slow rates of growth earlier experienced more rapid rates after 1955.

In some cases, the early higher rates probably reflect a return to normalcy in countries where production was disrupted during World War II by either direct involvement in hostilities or disruption of normal trade channels. However, a few of the countries so affected--notably Poland, Spain, and Thailand--had slower rates of increase in crop output during 1948-55 than during 1955-63.

In other cases, the impetus to early increases in output may have been provided by major agricultural development projects, such as a large new land settlement or irrigation project. But after potentials of these projects are exploited, rates of increase in crop output decline unless offset by other new development projects.

The earlier rapid rates of increase may also reflect a "catching up" in the exploitation of simple, easily made improvements in agricultural production. Consistent with this possibility, some of the countries with much higher rates of increase in output in the latter period may perhaps have gotten a later start in their programs to increase agricultural productivity. Like those starting earlier, these too may soon exhaust their simple, easily exploited opportunities for increasing output.

This last hypothesis suggests that once countries "catch up" on simple, easily made improvement opportunities, their further progress depends upon major structural changes, such as development of improved technologies and improvements in credit, marketing, educational, and research facilities. In addition to organizing and promotional abilities, these kinds of improvements require new capital investments and considerable time for full fruition. There is no inherent reason, of course, why less-developed countries cannot begin building the foundations for sustained progress, even while using benefits of the simpler improvement opportunities that they now have.

Changes in Crop Output Relative to Growth in Food Demand

For the period 1948-63, 8 of the 26 study countries had annual compound rates of increase in crop production exceeding their 1950-60 rate of growth in domestic food demand. These countries were Israel, Sudan, Mexico, the Philippines, Tanganyika, Greece, Iran, and Argentina (table 5). Argentina falls in this group, not because of the successful performance of its agricultural sector, but because of its low population growth rate combined with little or no increase in per capita income.

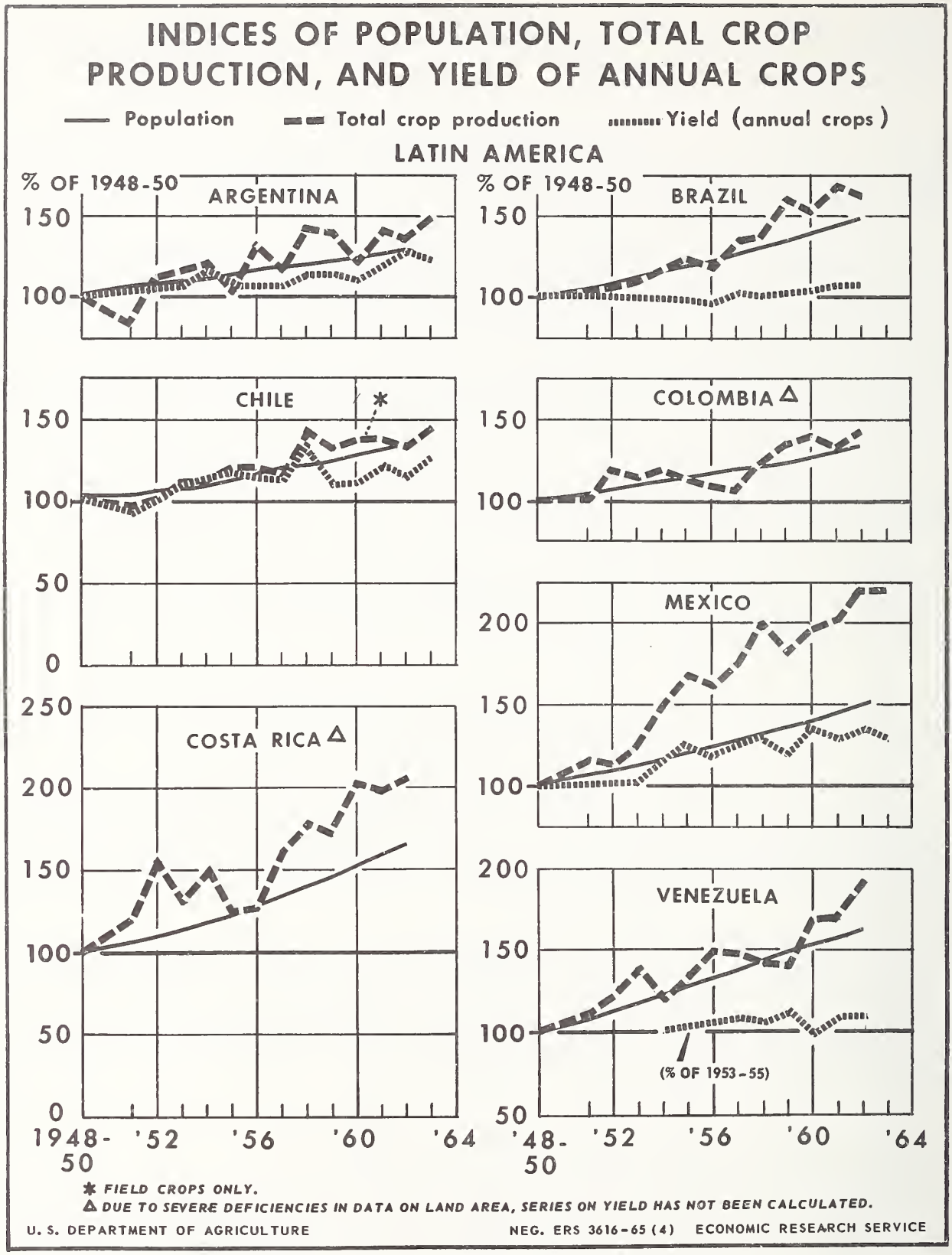
INDICES OF POPULATION, TOTAL CROP PRODUCTION, AND YIELD OF ANNUAL CROPS
Population
Total crop production
Yield (annual crops)
LATIN AMERICA
% OF 1948-50
ARGENTINA
BRAZIL
CHILE
*
COLOMBIA Δ
MEXICO
COSTA RICA Δ
VENEZUELA
(% OF 1953-55)
150
100
50
0
250
200
1948-50
'52
'56
'60
'64
* FIELD CROPS ONLY.
Δ DUE TO SEVERE DEFICIENCIES IN DATA ON LAND AREA, SERIES ON YIELD HAS NOT BEEN CALCULATED.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3616-65 (4) ECONOMIC RESEARCH SERVICE

Figure 2

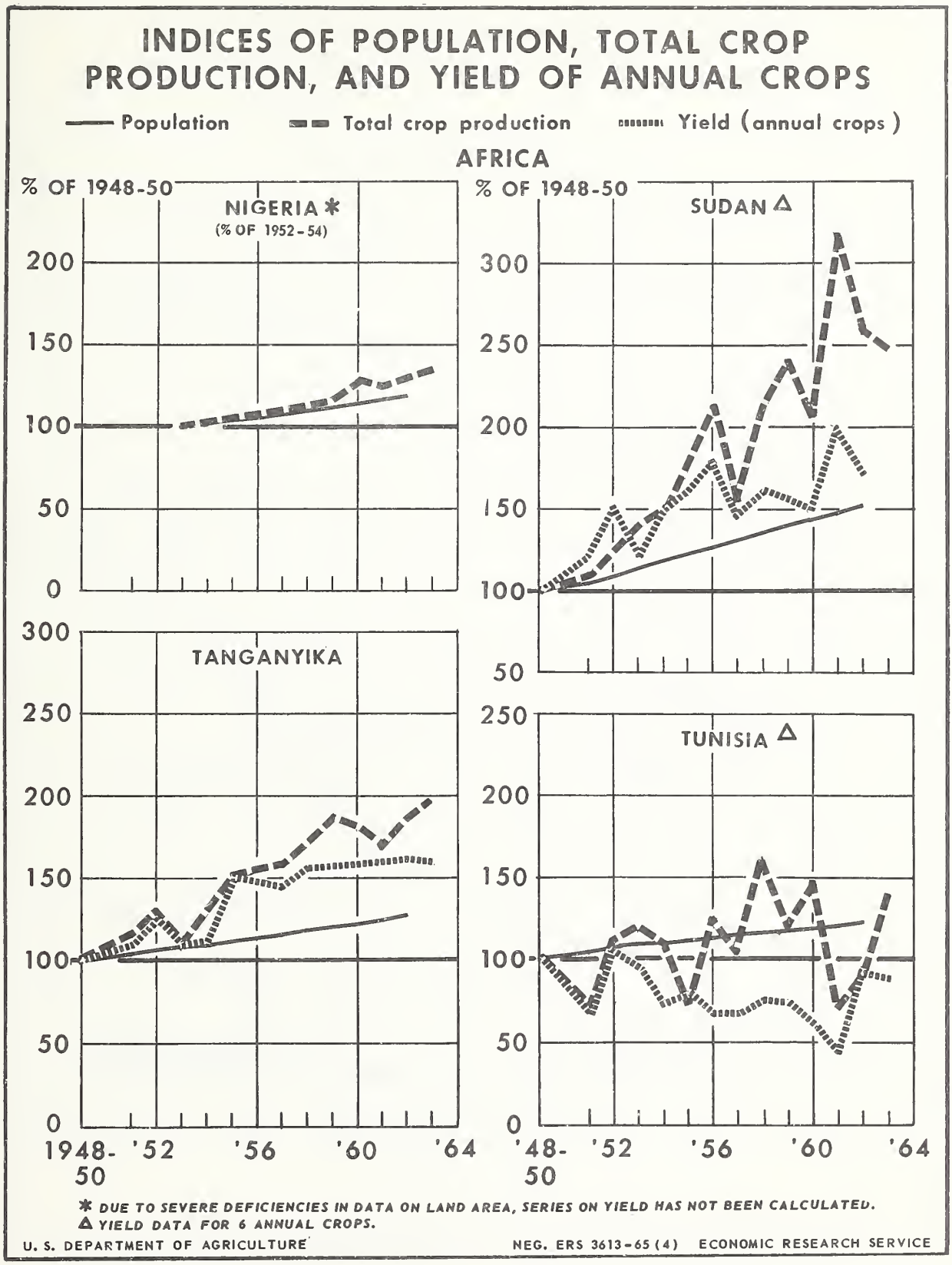
INDICES OF POPULATION, TOTAL CROP PRODUCTION, AND YIELD OF ANNUAL CROPS
Population
Total crop production
Yield (annual crops)
AFRICA
% OF 1948-50
NIGERIA *
(% OF 1952-54)
SUDAN △
TANGANYIKA
TUNISIA △
200
150
100
50
0
300
250
1948-50
'52
'56
'60
'64
* DUE TO SEVERE DEFICIENCIES IN DATA ON LAND AREA, SERIES ON YIELD HAS NOT BEEN CALCULATED.
△ YIELD DATA FOR 6 ANNUAL CROPS.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3613-65 (4) ECONOMIC RESEARCH SERVICE

Figure 3

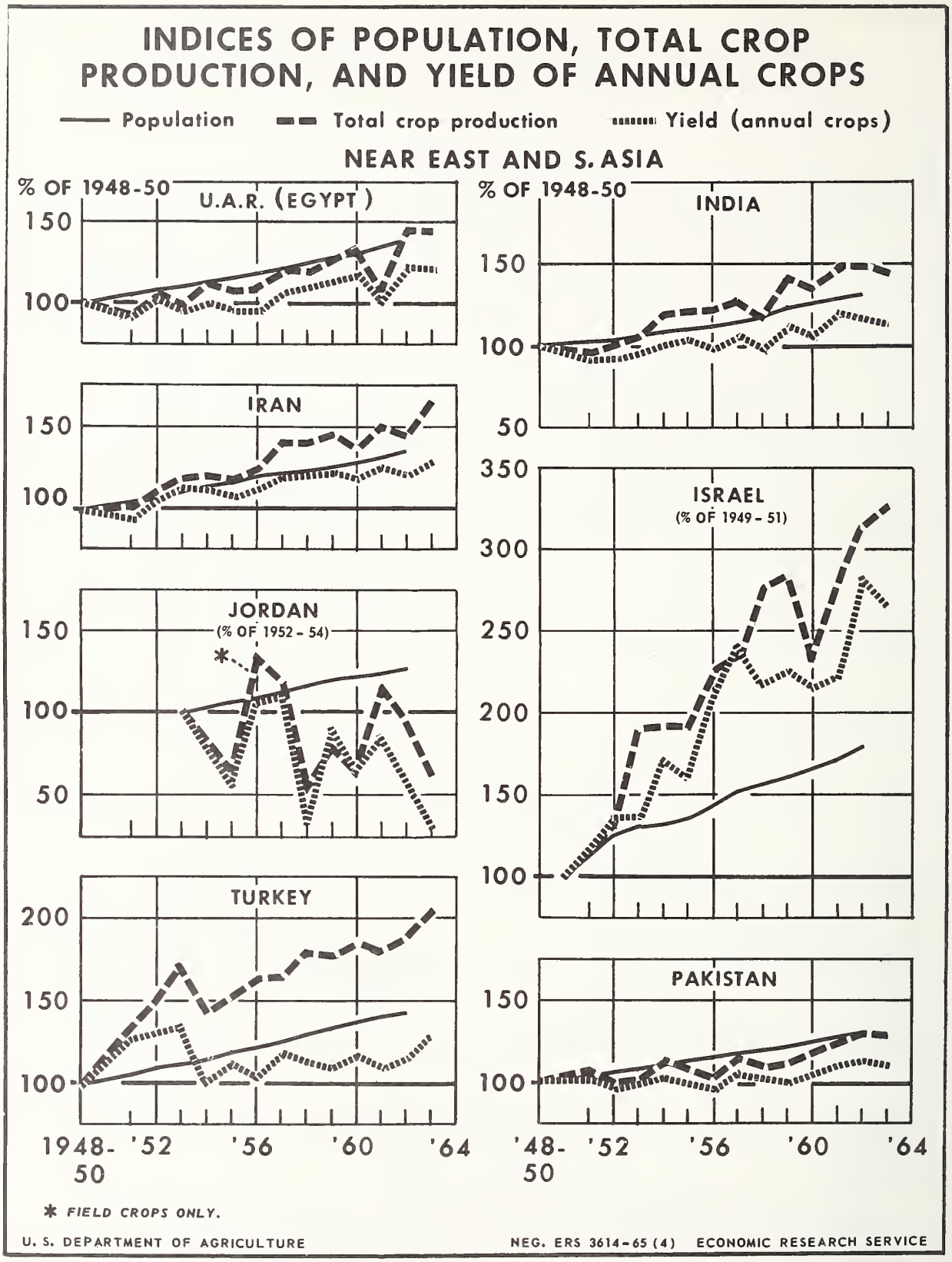
INDICES OF POPULATION, TOTAL CROP PRODUCTION, AND YIELD OF ANNUAL CROPS
Population
Total crop production
Yield (annual crops)
NEAR EAST AND S. ASIA
% OF 1948-50
U.A.R. (EGYPT)
150
100
IRAN
JORDAN
(% OF 1952 - 54)
50
TURKEY
200
INDIA
ISRAEL
(% OF 1949 - 51)
350
300
250
PAKISTAN
1948-50
'52
'56
'60
'64
* FIELD CROPS ONLY.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3614-65 (4) ECONOMIC RESEARCH SERVICE

Figure 4

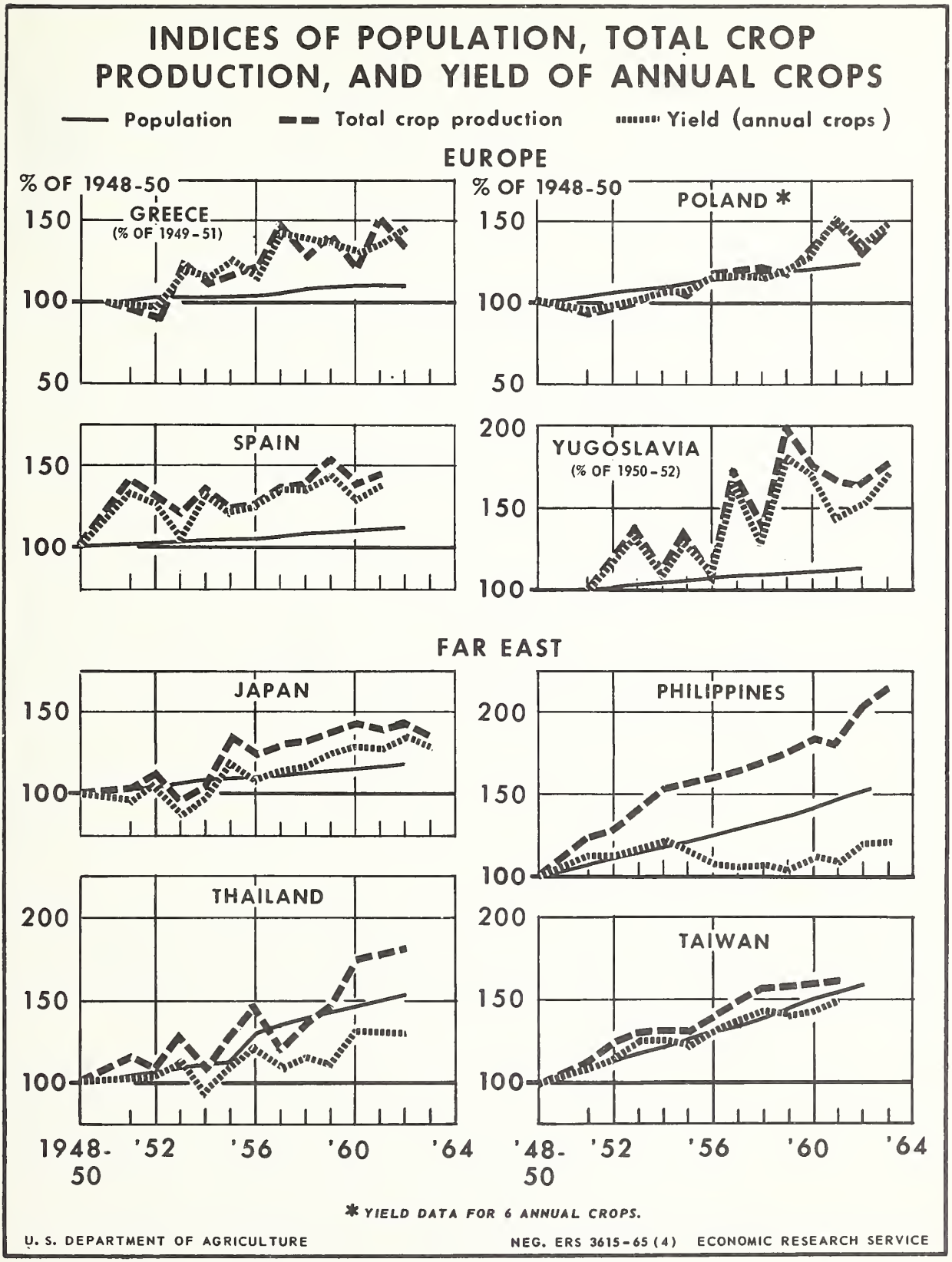
INDICES OF POPULATION, TOTAL CROP PRODUCTION, AND YIELD OF ANNUAL CROPS
Population
Total crop production
Yield (annual crops)
EUROPE
% OF 1948-50
GREECE
(% OF 1949-51)
POLAND *
SPAIN
YUGOSLAVIA
(% OF 1950-52)
FAR EAST
JAPAN
PHILIPPINES
THAILAND
TAIWAN
150
100
50
200
1948-50
'52
'56
'60
'64
* YIELD DATA FOR 6 ANNUAL CROPS.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3615-65 (4) ECONOMIC RESEARCH SERVICE

Figure 5

Table 5.--Difference between rate of increase in crop output and domestic food demand growth rates, 26 study countries and United States, selected periods

Country	Rate of growth in domestic food demand, 1950-60	Crop output					
		1948-63		1948-55		1955-63	
		Rate of change	Surplus over food demand	Rate of change	Surplus over food demand	Rate of change	Surplus over food demand
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Group I	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Israel.....	6.6	9.7	3.1	15.9	9.3	5.7	-0.9
Sudan.....	3.9	8.0	4.1	10.2	6.3	5.8	1.9
Mexico.....	4.2	6.3	2.1	8.5	4.3	4.1	-0.1
Costa Rica.....	6.1	5.6	-0.5	4.6	-0.5	7.9	1.8
Philippines.....	4.5	5.2	0.7	8.1	3.6	3.2	-1.3
Tanganyika.....	2.5	5.2	2.7	6.4	3.9	3.1	0.6
Yugoslavia.....	6.4	5.1	-1.3	6.1	-0.3	4.3	-2.1
Taiwan.....	5.5	4.5	-1.0	5.4	-0.1	3.6	-1.9
Turkey.....	4.5	4.5	0.0	6.0	1.5	3.1	-1.4
Venezuela.....	6.2	4.5	-1.7	5.0	-1.2	4.4	-1.8
Thailand.....	4.9	4.4	-0.5	3.9	-1.0	5.4	0.5
Brazil.....	4.5	4.2	-0.3	3.7	-0.8	5.2	0.7
Greece.....	3.3	3.7	0.4	5.7	2.4	1.7	-1.6
Average.....	4.9	5.5	0.6	6.9	2.1	4.5	-0.4
Group II							
Iran.....	2.6	3.6	1.0	3.8	1.2	3.3	0.7
India.....	3.5	2.1	-0.4	3.2	-0.3	3.0	-0.5
Poland.....	5.1	3.0	-2.0	2.4	-2.7	3.6	-1.5
Argentina.....	1.7	2.8	1.1	2.7	1.0	2.9	1.2
Chile.....	3.0	2.8	-0.2	3.0	0.0	2.3	-0.7
Japan.....	4.4	2.8	-1.6	4.3	-0.1	1.3	-3.1
Spain.....	3.0	2.7	-0.3	2.5	-0.5	2.9	-0.1
Colombia.....	3.5	2.6	-0.9	1.5	-2.0	4.3	0.8
Nigeria.....	4.9	2.6	-2.3	2.6	-2.3	2.6	-2.3
UAR.....	4.0	2.0	-2.0	0.7	-3.3	2.8	-1.2
Pakistan.....	2.4	1.8	-0.7	-0.1	-2.5	2.8	0.3
Tunisia.....	2.9	1.6	-1.3	1.8	-1.1	1.4	-1.5
Jordan.....	3.7	-1.9	-5.6	-2.2	-5.9	-1.9	-5.6
Average.....	3.5	2.3	-1.2	2.0	-1.5	2.4	-1.1
United States...	1.8	0.8	1.0	-0.1	-1.9	1.9	0.1

Source: Based on data in tables 2 and 4.

Since 1955, crop output relative to growth in domestic food demand has dropped in several of the study countries. Some of these, such as Japan, Israel, and Venezuela, now produce enough industrial products to exchange some of them in world markets for food to feed their growing population. In still predominantly agricultural countries, however, the failure of increases in agricultural output to keep up with growth in domestic demand can hardly help but slow down general economic growth.

The above observations indicate that, to achieve general economic development, several of the study countries need to direct greater effort to increasing their agricultural output, and perhaps to solving their population growth problems as well. Although the recent record of several countries is disappointing, the successful experiences of a few warrant the hope that, with appropriate policies and programs, underdeveloped countries can substantially increase their agricultural output and productivity in the decade ahead. This hope is bolstered by the fact that these successes and near successes have been achieved by countries which differ widely in their soil and climatic conditions, historical backgrounds, ethnic, educational, and other cultural features, man-land ratios, and proximity and accessibility to major world markets. Moreover, some of the crops through which these successes have been achieved are widely grown in both temperate and tropical climatic zones (Chapter 2).

Elements Associated With Differences in Levels and Rates of Change in Agricultural Output

Limitations in available information have in some cases necessitated reliance on rather crude indicators of the factors underlying differences among the study countries in their level and rates of increase in crop output. For instance, the level and changes in the amount of fertilizers per hectare of arable land are used as measures of relative level and changes both in variable agricultural capital and in applied technology.

Differences in Output Per Agricultural Worker

Because of data limitations, the gross value of agricultural production per agricultural worker has been calculated for only 19 of the 26 countries (table 6, column 1). In U.S. dollars, the 1960 output (including both crops and livestock) per worker varied among these 19 countries from highs of $1,825 and $1,080 in Israel and Argentina, respectively, to a low of $94 in Thailand. Output per worker had a value of from $500 to around $655 in 5 other countries--Spain, Poland, Chile, Colombia, and Venezuela. It was $402 per worker in Japan. In Japan, agriculture is closely intertwined with small-industry operations, a setup which permits much part-time farming. Hence, agricultural output of many Japanese agricultural workers is substantially augmented by their earnings from nonfarm sources. In India, the Philippines, Pakistan, and Thailand, value of output per worker was less than $200.

Table 6.--Agricultural output per agricultural worker and factors associated with differences in output, 19 study countries, 1960

Country	Agricultural output per farm worker[1]	Total land per capita of total population[2]	Arable land per agricultural worker[3]	Illiteracy rate[4]	Infant mortality rates per 1,000[5]	Agricultural workers per hectare of arable land[6]	Fertilizer used per hectare of arable land[7]	Urban population as a percentage of total population[8]	Rank of country in miles of road per 1,000 sq. mi. of land area[9]	Agricultural output per hectare of arable land[10]	Gross domestic product per capita[11]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Group I	Dollars	Hectares	Hectares	Percent	Number	Number	Metric tons	Percent	Rank	Dollars	Dollars
Israel.....	1,825	0.9	4.1	6	32.0	0.31	80.5	77.3	3	557	905
Argentina..	1,080	12.5	13.1	14	59.6	.07	NA	67.0	16	78	465
Spain.....	656	1.6	4.4	18	51.6	.23	31.6	NA	7	150	372
Poland.....	616	1.0	2.4	5	74.7	.41	49.0	48.1	2	252	538
Chile.....	547	9.1	9.3	20	118.0	.11	17.0	67.2	12	59	405
Colombia...	531	7.7	1.9	38	100.0	.51	NA	NA	18	270	248
Venezuela..	500	12.5	3.2	48	64.1	.30	3.8	66.1	17	150	650
Japan.....	402	0.4	0.4	2	37.7	2.39	303.7	63.5	1	961	337
Greece.....	391	1.6	1.9	20	41.4	.52	38.0	42.5	5	205	297
Mexico.....	369	5.6	4.1	35	77.7	.30	9.4	50.7	11	110	321
Average..	692	5.3	4.5	21	65.7	0.52	66.6	60.3	9	279	454
Group II											
UAR.....	365	3.7	0.6	80	130.1	1.76	87.0	37.7	15	643	155
Turkey.....	326	2.7	2.6	61	NA	.39	1.5	37.8	13	127	254
Yugoslavia.	250	1.4	1.8	23	98.5	.57	28.0	NA	4	141	179
Brazil.....	229	11.1	1.4	51	NA	.45	13.0	45.1	14	104	145
Taiwan.....	228	0.3	0.6	46	34.2	2.10	203.8	59.5	6	477	97
Pakistan...	182	1.0	1.5	81	NA	.73	3.2	NA	10	133	64
Philippines	181	1.0	1.2	25	82.6	.77	12.5	42.7	9	139	113
India.....	114	0.7	1.2	76	145.9	.80	2.3	17.9	8	91	70
Thailand...	94	1.9	0.9	32	54.8	1.13	2.3	11.8	19	106	84
Average...	222	2.6	1.3	53	91.0	0.97	39.3	36.1	11	218	129

[1] From column 3, table 49.
[2] Calculated from FAO Production Yearbooks.
[3] Calculated from data in column 3, table 49.
[4] Calculated from data in table 54.
[5] From table 52.
[6] From column 13, table 67.
[7] Calculated from data in FAO Production Yearbook, 1961.
[8] From column 2, table 71.
[9] Data from U.N. Compendium of Social Statistics, 1962.
[10] From column 10, table 67.
[11] From column 3, table 67.

Data in table 6 on factors associated with these differences in output per worker yield no one simple explanation for the differences. Generally, however, the top 10 countries in value of output per worker had much more arable land per worker than did those in the lower part of this array (table 6, column 3). Use of fertilizer inputs per hectare of land as a measure of variable capital inputs generally and as a rough indicator of level of applied technology shows that 7 of the 10 top countries were well above average in their inputs of variable capital, whereas among the 9 lower countries in this array, only 2 were above average (table 6, column 7). Use of literacy levels as a measure of educational levels, shows that, in 7 of the top 10 countries, 70 percent or more of the population over 15 years of age was literate, whereas only 2 of the 9 countries in the lower part of the array had similar literacy rates (table 6, column 4).

Exceptions to these general relations can be accounted for by one or more other compensating factors. For example, Japan had only 0.4 hectare of arable land per worker, compared with 13.1 in Argentina and 4.1 in Israel (table 6, column 3). But in inputs of variable capital per hectare of land (based on use of fertilizers), Japan ranked among the top 2 or 3 countries of the world (column 7). Its inputs of nonconventional capital (in the form of improved technologies and investments in the human factor) in agriculture are probably the highest per hectare of arable land of any country in the world. Thus, in Japanese agriculture, capital invested in both conventional and nonconventional inputs has become a tremendously important substitute for land. It accounted for output valued (in U.S. dollars) at close to $1,000 per hectare, compared with only $91 per hectare in India; this was the case even though the natural fertility of land is as high in India as in Japan. If, in 1960, India had had as high a value of output per hectare of arable land as Japan, its value of output per agricultural worker would have been about $1,150 instead of $144.

Generally, a high value of output per agricultural worker is associated with a relatively high level of general economic development, as measured by gross domestic product per capita of total population (table 6, column 11). This is so because of the interdependence between farm and nonfarm sectors in the processes of development. Each sector contributes to development of the other, making for larger rates of growth than would be possible if either operated singly. Growth in the nonfarm sector leads to larger markets for agricultural commodities and, generally, to increases in the supply of manufactured production requisites--such as implements, fertilizer, and pesticides--available to farmers. Hence, farmers in the more highly developed countries have important advantages over producers in less-developed countries.

Countries ranking high in value of agricultural output per farm worker also stand apart from the others in their infrastructure features, such as roads and other transport facilities, electric power facilities, hospitals, schools, and research institutions. While these features are essential for development, they are as much products of, as contributors to, development.

Differences in Rates of Increase in Crop Output

Increases in a country's agricultural output are a function of changes in the quantity and quality of its human resources, land, capital, technical knowledge, and production incentives. These factors are reflected in or influenced by price-cost relations, tenurial arrangements, tax practices, and other things affecting relations between effort and its rewards. If one country increases its agricultural output at a more rapid rate than do others, it does so because it excels the others in improving this complex of factors, because of unique circumstances giving it a larger potential for progress than other countries possess, or because of the willingness of its leaders and people to make greater effort and sacrifices.

Data on 20 factors associated with recent increases in crop output in the study countries for 1948-63 are shown in table 7.

Table 7.--Annual rate of change in crop output and associated resource and market factors, 26 study countries, selected periods

Country	Annual rate of change in crop output, 1948-63[1]	Land features		Human resource features			Capital and credit features			
		Arable land expansion potential[2]	Increase in area of crops[3]	Population growth rate[4]	Illiteracy rate[5]	Health conditions[6]	Increase in fertilizers per hectare of arable land[7]	Gross fixed capital formation in agriculture per agricultural worker, 1953-61[8]	Annual growth in volume of agricultural credit from institutional sources, 1953-61[9]	Growth in cooperative credit societies membership, 1950-60[10]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Group I	Percent	Rating[21]	Percent			Rating[21]	Kg.	Dollars	Percent	
Israel	9.7	4	68.5	5.2	4	1	81.5	673	3.6	NA
Sudan	8.0	1	49.9	3.4	93	3	2.2	NA	NA	NA
Mexico	6.3	3	49.7	3.1	35	2	8.9	NA	3.3	37
Costa Rica	5.6	NA	NA	3.9	21	2	64.2	NA	NA	NA
Philippines	5.2	4	66.9	3.2	25	2	2.7	4	17.2	59
Tanganyika	5.2	1	58.8	1.8	93	3	NA	NA	NA	NA
Yugoslavia	5.1	4	6.8	1.1	23	1	36.5	66	NA	NA
Taiwan	4.5	4	11.7	3.4	43	1	101.9	30	NA	4
Turkey	4.5	4	62.0	2.9	61	2	2.1	NA	5.6	105
Venezuela	4.5	1	54.0	4.0	48	2	3.6	178	0.8	NA
Thailand	4.4	3	29.5	3.2	32	2	1.7	1	NA	4
Brazil	4.2	1	54.6	3.1	51	3	8.7	NA	6.4	NA
Greece	3.7	4	22.3	1.0	20	1	66.6	29	7.1	NA
Average	5.5	2.83	44.6	3.0	42	1.92	31.7	140	5.5	42
Group II										
Iran	3.6	2	38.6	2.2	85	NA	NA	NA	NA	NA
India	3.1	4	26.0	2.0	76	3	2.8	3	18.3	232
Poland	3.0	4	-0.9	1.8	5	1	33.4	NA	NA	NA
Argentina	2.8	1	2.7	1.7	14	1	0	NA	NA	NA
Chile	2.8	3	14.0	2.5	20	2	8.4	NA	18.8	NA
Japan	2.8	4	0.9	1.2	2	1	125.3	47	23.7	-1
Spain	2.7	NA	3.1	0.8	13	1	22.6	NA	NA	NA
Colombia	2.6	1	11.5	2.2	38	3	6.2	NA	0.4	NA
Nigeria	2.6	NA	NA	3.7	89	3	NA	NA	NA	592
UAR	2.0	3	6.2	2.4	80	3	62.7	19	7.5	190
Pakistan	1.8	NA	13.9	2.2	81	3	5.5	6	NA	NA
Tunisia	1.6	4	14.7	1.8	84	1	0	NA	4.2	NA
Jordan	-1.9	NA	-7.5	2.6	68	2	1.5	NA	NA	NA
Average	2.3	2.89	10.3	2.1	50	2.00	29.8	19	9.1	253

Country	Technological features				Tenure features		Marketing facilities[17]	Availability of production requisites[18]	Fertilizer prices[19]	Annual rate of increase in domestic food demand[20]
	Increase in crop output per acre of crops 1948-63[11]	Agricultural research programs during 1950's[12]	Agricultural extension and education programs[13]	Seed status[14]	Percentage and conditions of tenancy[15]	Tenure improvement programs[16]				
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Group I	Percent	Rating[21]								Percent
Israel	116.3	1	1	NA	1	1	1	1	1	6.58
Sudan	74.8	2	1	NA	3	1	3	2	1	3.91
Mexico	29.0	2	2	1	1	1	1	1	NA	4.20
Costa Rica	NA	2	2	NA	2	2	1	2	NA	6.12
Philippines	12.6	2	2	NA	3	2	2	2	2	4.48
Tanganyika	16.9	3	2	NA	3	3	3	3	NA	2.50
Yugoslavia	35.5	2	1	1	1	1	1	1	1	6.35
Taiwan	43.8	1	1	NA	1	1	1	1	3	5.73
Turkey	16.4	2	2	2	2	2	3	2	NA	4.47
Venezuela	6.4	3	2	NA	2	1	1	2	3	6.20
Thailand	31.1	2	3	NA	3	2	3	2	3	4.93
Brazil	6.5	3	3	NA	2	3	2	2	NA	4.43
Greece	43.3	2	1	NA	2	1	2	2	1	3.30
Average	36.1	2.08	1.77	1.33	2.00	1.62	1.85	1.77	1.88	4.86

See footnotes at end of table.

Table 7.--Annual rate of change in crop output and associated resource and market factors, 26 study countries, selected periods--Continued

Country	Technological features				Tenure features		Marketing facilities[17]	Availability of production requisites[18]	Fertilizer prices[19]	Annual rate of increase in domestic food demand[20]
	Increase in crop output per acre of crops, 1948-63[11]	Agricultural research programs during 1950's[12]	Agricultural extension and education programs[13]	Seed status[14]	Percentage and conditions of tenancy[15]	Tenure improvement programs[16]				
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Group II	Percent	Rating[21]								Percent
Iran	18.8	3	3	3	3	2	2	3	3	2.24
India	14.3	2	3	2	3	2	3	2	3	3.36
Poland	41.3	2	1	1	2	1	2	1	NA	5.10
Argentina	23.5	2	2	2	2	3	1	1	NA	1.68
Chile	15.7	2	3	NA	2	2	1	3	NA	3.05
Japan	31.2	1	1	1	1	1	1	1	2	5.61
Spain	36.9	2	3	NA	2	2	1	2	1	2.98
Colombia	48.3	3	3	NA	3	2	2	3	NA	3.46
Nigeria	NA	3	2	NA	3	3	3	3	NA	4.92
UAR	22.3	2	3	2	1	1	3	2	3	4.02
Pakistan	11.9	2	2	2	2	2	3	3	1	2.44
Tunisia	-34.4	3	1	1	2	2	3	2	NA	2.90
Jordan	-2.5	3	2	3	1	1	2	1	NA	3.70
Average	18.9	2.31	2.23	1.89	2.08	1.85	2.08	2.08	2.17	3.50

[1] From column 1, table 4.
[2] From table 14.
[3] From table 9.
[4] From table 2.
[5] From table 54.
[6] From table 52.
[7] From table 35.
[8] Data provided by FAO.
[9] Data provided by FAO.
[10] Data provided by FAO.
[11] From table 9.
[12] Estimates based on available data.
[13] Estimates based on available data.
[14] From column 2, table 45.
[15] Estimates based on data presented in Chapter 4.
[16] Estimates based on data in Chapter 4 and on other reports reviewed by staff.
[17] From column 2, table 73.
[18] From data provided by USAID missions, see Appendix II, table 83.
[19] Based on data in table 40 and on data from FAO reports.
[20] From table 2.
[21] In all ratings in this table, the lower numbers represent the more favorable situation and the higher numbers the less favorable situation.

Each of the study countries has its own unique combination of human, land, and capital resources and technical possibilities, as well as its own distinct institutional, social, and political features. Hence, it would logically follow that the proportionate combination of changes in resource patterns needed to maximize rates of increase in agricultural production would differ from country to country. It is probably for this reason that we do not find a highly consistent relationship between changes in any one factor and rates of change in crop output. What we do find is a tendency for countries with a rapid rate of increase either to excel in a fairly large number of the factors or to excel greatly in one or two important factors. Israel, for example, had substantial increases in area of crops (table 7, column 3), in variable and fixed capital per hectare of arable land, in level of applied technology (table 7, column 11), and in the size of its agricultural labor force (table 7, column 5). It also ranked high in educational and health levels (table 7, columns 5 and 6).

In contrast to Israel's balanced approach, the progress of the Philippines and Tanganyika appears to have been achieved by heavy emphasis upon expanding their area under cultivation. During the 1950's, neither of these countries made large improvements in level of applied technology, in use of variable capital per unit of land, or in the educational level of its human resources.

At the farm level, increases in crop output have been mainly a function of increases in number of agricultural workers, in area of crops, and in amounts of both variable and fixed capital, and improvements in the level of applied technology. In most of the study countries, each of these four factors accounts for at least part of the increases in crop output. As indicated above, relative importance of changes in these four factors differed greatly from country to country and no one proportionate combination differentiated the rapid-growth from the slow-growth countries. Nevertheless, during the 1950's rapid-growth countries generally excelled slow-growth countries in the magnitude of changes

made in most of these factors. For example, when countries were arrayed by rate of increase in crop output per year, those in the upper half of the array (Group I) had an average increase in area of crops of 44.6 percent, compared with 10.3 percent for those in the lower half (column 3, table 7). Gross fixed capital formation per agricultural worker was $140 for countries in the upper half, compared with $19 for those in the lower half (column 8, table 7).

Over a longer period of time, investments in education and in nutrition and health would probably have further differentiated rapid from slower rates of growth. These kinds of investments, like those in research and in other such institutions, however, require a considerable amount of time for their full fruition. In the short time period covered by this study, it is doubtful that differences among countries in improvements in the human agent account for much of the differences in their rates of increase in crop output.

In less-developed countries, large resource changes at farm levels are seldom made unless accompanied or preceded by large improvements in the infrastructure of roads, marketing facilities, credit agencies, research and educational institutions serving farm people. Some countries also require large improvements in incentives to producers, price-cost relations, tenurial arrangements, and tax policies.

Available information on the extent to which these kinds of improvements have been made in the study countries is even more limited than that on factors entering directly into production at farm levels. Such evidence as is available, however, shows that rapid rates of increase in crop output have not just been a consequence of normal economic and social processes in societies organized on a laissez-faire basis. Rather, they have been undergirded by aggressive group action--generally national in scope--which has been directed specifically to improving agricultural service facilities. Such action has included major land development programs, especially the opening up of new lands and the development of irrigation facilities in Israel, Sudan, Mexico, the Philippines, Taiwan, and Brazil (table 7); major land reform programs in Japan, Taiwan, and, in earlier decades, in Mexico; and increasing emphasis on agricultural education in Israel, Sudan, Mexico, Taiwan, and Greece. Expanded programs of agricultural research have been particularly important in improving the technological basis of agricultural production in Mexico, Taiwan, and Japan. Significant improvements in agricultural credit facilities have been made in Mexico, the Philippines, and Taiwan. The extension of improved roads which have more fully opened large new areas to a market economy has been largely responsible for increasing crop output in Turkey, especially for that made between 1948 and 1955.

Countries with more rapid rates of increase in crop output also had higher rates of increase in domestic food demand. Rates of increase in domestic food demand for the upper and lower groups, respectively, were 4.74 percent and 3.50 percent (column 20, table 7). The former group of countries had an average annual rate of increase in per capita incomes of 3.25 percent, compared with an average of 2.34 percent for countries having the slower rate of increase. These observations suggest that growth in the agricultural sector is often needed to facilitate growth in the rest of the economy and vice versa.

Differences in Crop Yield Increases

Estimates which distinguish between increases in area of crops and in crop yields as sources of increases in crop output have been developed for 22 of the 26 study countries. Increases in area of crops were the more important source of crop output increases in 10 of the 22 countries and crop yield increases were more important in 12 (table 8). Many countries, particularly in Latin America and Central and South Africa, still have sizeable land expansion potentials (table 14). Many other countries, however, will have to achieve their increases in output mainly through increases in crop yields. Even in some countries with sizeable land expansion potentials, increasing yields may be the better means of increasing their agricultural output. Yet, most countries making rapid progress had substantial increases in both area of crops and crop output per unit of land.

In terms of their physical and technical bases, recent yield increases in the study countries have been achieved mainly through increased use of fertilizers, use of improved crop varieties, more effective pest controls, improvements in planting, tillage, and harvesting methods, and better use of water resources. Often, improvements have been made as part of a system of improved production practices. Some of these changes have provided additional employment for labor and have required some additional capital.

Available information is too sketchy for precise measurement of the relative contribution of these factors to the increases made in crop yields during the last decade. Under the assumption of the rather high incremental response ratio of 10 pounds of grain to 1 pound of fertilizer, increased use of fertilizers probably does not account for more than 20 percent of the increases in grain yields made in India, for example. The use of pesticides is still too limited to have accounted for more than 4 to 5 percent of these yield increases. If we consider all purchased inputs, including improved seeds, it appears that the larger part of the recent yield increases in India has come about mainly through simple improvements requiring few purchased inputs, such as better spacing of plants, better weed control, and better tillage practices. These are kinds of improvements that are effected by technical assistance and agricultural education programs.

Most countries in the early stages of agricultural development have these kinds of yield-increasing opportunities. Exploitation of these opportunities can be strategic to their economic development, but by themselves these opportunities cannot bring the less-developed countries very far up the yield-increasing scale. Rather, large progress in increasing yields depends on purchased inputs and on kinds of inputs produced through investments in research and agricultural extension.

CHAPTER 2.--SOURCES OF CHANGE IN CROP OUTPUT

This section is concerned with the physical resource and commodity basis of recent changes in crop output in the study countries. Such information has a bearing on some very important hypotheses, as those relating to the existence of cheap sources of output increases and those relating to the availability of adaptable technologies and crops for increasing output in tropical and semitropical regions.

Annual data on the land area associated with the output of each crop indicate the following sources of change in crop production: (1) Changes in area of crops; (2) changes in crop pattern as from high- to low-value crops, or vice versa; and (3) changes in crop yields (table 8). Estimates of how much of the changes in output have come from changes

Table 8.--Sources of recent changes in production of field crops for 22 study countries, selected years[1]

Country	Time span	Annual rate of increase in crop output[2]	Source of change			
			Area of crops[3]	Crop pattern	Crop yield	Total
Group I	Years	Percent	Percent	Percent	Percent	Percent
Israel.....	1948-63	9.7	25.8	-2.6	76.8	100.0
Sudan.....	1948-62	8.0	30.8	22.2	47.0	100.0
Mexico.....	1948-60	6.3	53.4	-0.1	46.7	100.0
Philippines.....	1948-62	5.2	76.0	5.4	18.6	100.0
Tanganyika.....	1948-63	5.2	68.7	4.7	26.6	100.0
Yugoslavia.....	1948-63	5.1	15.2	5.6	79.2	100.0
Taiwan.....	1948-61	4.5	19.3	-3.5	84.2	100.0
Turkey.....	1948-63	4.5	70.0	-0.6	30.6	100.0
Venezuela.....	1953-62	4.5	84.6	-18.6	34.0	100.0
Thailand.....	1948-62	4.4	42.2	13.5	44.3	100.0
Brazil.....	1948-62	4.2	84.3	1.5	14.2	100.0
Greece.....	1948-62	3.7	29.6	6.5	63.9	100.0
Group II						
Iran.....	1948-63	3.6	59.7	13.4	26.9	100.0
India.....	1948-62	3.1	59.1	8.0	32.9	100.0
Poland.....	1948-63	3.0	-2.3	26.9	75.4	100.0
Argentina.....	1948-63	2.8	10.0	18.6	71.4	100.0
Chile.....	1948-63	2.8	43.7	26.4	29.9	100.0
Japan.....	1948-63	2.8	2.8	20.2	77.0	100.0
Spain.....	1948-61	2.7	7.5	14.8	77.7	100.0
Colombia.....	1948-62	2.6	17.6	-3.2	85.6	100.0
UAR.....	1948-63	2.0	20.7	7.7	71.6	100.0
Pakistan.....	1948-63	1.8	50.7	14.2	35.1	100.0

[1] Data on land area in crops are not available for Costa Rica and Nigeria. Year-to-year variations in agricultural production in Jordan and Tunisia have been too erratic for statistically reliable results.

[2] Annual compound rates for field crops and other crops combined.

[3] Includes multiple cropping.

in land area are based on the assumption that newly cultivated land is of the same quality as that already in use. These estimates are expressed in value aggregates and have been computed on a crop-by-crop basis; they take into account changes in land area but assume no change in crop yields. The residual of the total change in value is ascribed to yield increases.

Change in Area of Crops

Increases in area of crops have been made in all of the study countries for which land area data are available, except in Poland. They account for more than half of the observed increases in crop production in four of the more rapid-growth (or Group I) countries--Mexico, Venezuela, Brazil, and Tanganyika. These increases in acres of crops are partly accounted for by increases in the production of two or more crops per year on the same land, but the larger part probably reflects increases in area under cultivation. All of these countries except Mexico still have large areas of unused land of known potential for agricultural production (Chapter 3). Argentina had only a 10-percent increase from this source; so by itself the mere availability of such land does not insure expansion of agriculture.

Land resources needed to feed man adequately exist in most of the world's underdeveloped countries. This is especially true in most of Central and South Africa, the Philippines, and South America where much potentially suitable land is not being used. Under present conditions, use of much of this land is not economically feasible. Technological advances, however, as well as shifts in the demand for food, may extend the economic margins of cultivation to include much of this land. Yield-increasing and labor-saving innovations, improved roads and transport facilities, and eradication of disease and insect pests, may particularly help to extend cultivable areas.

Rapid population growth in the densely populated Asian countries has become a source of apprehension. Although these countries have relied less upon expanding land area to increase production than have African and Latin American countries, considerable expansion of the area of crops has occurred in India, Pakistan, and even Egypt. In these and other densely populated countries, it is unlikely that reorganization of producing units to bring additional land into use will continue to make large contributions to increasing agricultural production. Rather, these countries will need to emphasize increased output per unit of land now in use. One way of doing this is to grow two or more crops per year on land where now only one crop is grown.

Data presented in table 8 on sources of increased output do not by themselves indicate the extent of changes that have been made in land area, yields, and crop patterns. Generally, however, countries in which crop area was the major source of change in output were also countries with substantially increased acres of crops (table 9). For example, from 1948-50 to 1961-63, Brazil increased its land area by 55 percent; Mexico by 50 percent; Venezuela by 54 percent; and Turkey by 62 percent. Taiwan, which is one of the world's most densely populated agrarian nations, increased its area of crops by 12 percent during this period. In most cases, increases in acres of crops were accompanied by increases in yields; the combination of these factors created rapid rates of increase in production. Multiple cropping probably accounts for some of these increases.

Change in Crop Patterns

Crop patterns have shifted from low- to high-value crops in about three-fourths of the countries and from high to lower value crops in about one-fourth. Such shifts have not accounted much for increases in total value of crop output.

Information on the commodity composition of changes in crop production is presented in table 10 for 24 of the study countries. Among the upper half of the countries, several kinds of crops account for a fifth or more of the total increases in value of crop production in one or more countries. These include maize in Mexico and Yugoslavia; wheat in

Table 9.--Recent changes in area of crops, crop output per unit of land, and crop yields for field crops, 22 study countries, selected years

Country	Time span	Annual rate of increase in crop output[1]	Changes in--		
			Area of crops	Crop output per unit of land[2]	Crop yields
Group I	Years	Percent	Percent	Percent	Percent
Israel	1948-63	9.7	68.5	116.3	120.4
Sudan	1948-62	8.0	49.9	74.8	50.8
Mexico	1948-60	6.3	49.7	29.0	28.9
Philippines	1948-62	5.2	66.9	12.6	9.8
Tanganyika	1948-63	5.2	58.8	16.9	14.4
Yugoslavia	1948-63	5.1	6.8	35.5	33.2
Taiwan	1948-61	4.5	11.7	43.8	45.7
Turkey	1948-63	4.5	62.0	16.4	16.7
Venezuela	1953-62	4.5	54.0	6.4	14.1
Thailand	1948-62	4.4	29.5	31.1	23.8
Brazil	1948-62	4.2	54.6	6.5	5.9
Greece	1948-62	3.7	22.3	43.3	39.3
Group II					
Iran	1948-63	3.6	38.6	18.8	12.5
India	1948-62	3.1	26.0	14.3	11.5
Poland	1948-63	3.0	-0.9	41.3	30.4
Argentina	1948-63	2.8	2.7	23.5	18.6
Chile	1948-63	2.8	14.0	15.7	8.3
Japan	1948-63	2.8	0.9	31.2	24.7
Spain	1948-61	2.7	3.1	36.9	31.0
Colombia	1948-62	2.6	11.5	48.3	50.2
UAR	1948-63	2.0	6.2	22.3	20.1
Pakistan	1948-63	1.8	13.9	11.9	8.5

[1] Annual compound rates for field crops and other crops combined.
[2] Includes combined influence of changes in crops and changes in yields.

Yugoslavia, Turkey, and Greece; rice in the Philippines and Taiwan; millet in Sudan; root crops--mainly yams and cassava--in Venezuela; sugar cane in the Philippines; vegetables and fruits in Israel; coffee in Costa Rica and Brazil; and cotton and other fibers in Israel, Sudan, Tanganyika, and Mexico.

These same kinds of crops are important to the economy of the slow-growth countries. For example, maize is grown extensively in Argentina and Chile; wheat in Iran, Poland, Argentina, Chile, Spain, and Egypt; rice in India; potatoes and yams or other root crops in Poland, Chile, and Nigeria; sugar crops in Poland and India; vegetables and fruits, including citrus, in Spain, Iran, Colombia, and Egypt; coffee, tea, and cocoa in Colombia and Nigeria; and cotton in Iran, Colombia, and Egypt. In fact, about 75 percent of all of the crops grown in the study countries measured in value terms are grown in both tropical and temperate climatic zones.

Table 10.--Distribution, by crops, of changes in total crop output, 24 countries arrayed by compound annual rate of increase in crop production, 1948-63

Country	Annual rate of change in all crops	Percentage distribution of the change in value of crop output by kind of crops									
		Maize	Wheat	Rice	Other cereals	Sorghum and millets	Pulses	Potatoes and yams	Other root crops	Sugar crops	Annual oilseed crops
Group I	Percent										
Israel	9.7	-0.1	4.2	--	1.6	2.9	-0.2	7.1	--	--	5.6
Sudan	8.0	0.7	0.7	--	--	21.6	7.2	--	--	--	29.1
Mexico	6.3	25.8	9.2	1.2	0.6	--	6.0	1.3	--	5.6	5.7
Costa Rica	5.6	3.2	--	8.0	--	--	2.4	--	--	6.8	--
Philippines	5.2	9.6	--	28.8	--	--	1.3	3.0	2.6	22.0	0.1
Tanganyika	5.2	12.4	1.0	5.8	--	--	--	--	--	--	3.2
Yugoslavia	5.1	31.8	27.0	--	2.9	--	2.2	12.0	--	3.4	1.0
Taiwan	4.5	0.7	2.2	47.8	--	0.2	1.2	9.5	0.8	9.0	10.2
Turkey	4.5	--	29.6	0.3	16.0	-0.1	1.9	7.1	--	4.5	3.2
Venezuela	4.5	11.4	-0.2	1.4	--	--	-2.1	12.8	4.5	16.7	5.9
Thailand	4.4	9.1	--	20.1	--	--	1.1	--	8.8	6.4	6.9
Brazil	4.2	13.2	-0.9	18.9	0.2	--	5.8	3.4	5.5	9.8	6.0
Greece	3.7	2.4	47.2	2.5	2.0	--	4.6	3.4	--	--	--
Group II											
Iran	3.6	--	25.7	7.0	4.9	--	2.9	--	--	4.9	7.8
India	3.1	4.0	14.0	32.5	0.9	5.4	7.7	--	--	13.5	10.3
Poland	3.0	--	12.4	--	16.2	--	-0.5	38.5	--	12.7	5.9
Argentina	2.8	17.3	6.9	0.9	1.7	0.7	-0.6	8.5	--	8.0	13.3
Chile	2.8	14.7	36.5	1.2	10.3	--	6.9	33.4	--	--	-3.2
Japan	2.8	0.3	0.7	52.5	-3.3	-0.6	3.5	4.0	--	1.2	5.0
Spain	2.7	0.3	0.3	0.1	--	--	0.1	0.3	--	--	--
Colombia	2.6	3.2	2.1	13.0	3.0	--	-1.1	6.2	--	1.6	3.6
Nigeria	2.6	2.4	--	2.4	--	12.7	2.5	13.7	9.4	0.2	19.5
UAR	2.0	12.6	13.8	16.0	0.1	2.7	2.8	6.8	--	9.7	4.8
Pakistan	1.8	1.3	4.7	48.5	-0.3	0.2	-0.9	--	--	21.1	9.5

Country	Percentage distribution of the change in value of crop output by kind of crops									
	Vegetables and fruits	Olives, palms, coconut, and copra	Nut crops	Coffee, tea, and cocoa	Tobacco	Rubber	Cotton	Other fibers	Other crops	Total
Group I	Percent									
Israel	62.1	0.7	--	--	--	--	16.1	--	--	100.0
Sudan	0.3	--	--	--	--	--	40.4	--	--	100.0
Mexico	7.9	3.6	--	8.7	1.5	--	22.1	0.8	--	100.0
Costa Rica	0.5	--	--	79.1	--	--	--	--	--	100.0
Philippines	11.3	9.7	--	5.7	5.3	--	--	0.6	--	100.0
Tanganyika	--	--	--	14.6	0.4	--	24.8	37.8	--	100.0
Yugoslavia	18.6	--	0.4	--	1.5	--	--	-0.8	--	100.0
Taiwan	10.1	--	--	2.3	3.0	--	0.5	1.3	1.2	100.0
Turkey	19.3	4.0	2.0	--	1.6	--	10.6	--	--	100.0
Venezuela	14.1	-1.3	--	-7.2	4.6	--	[1] 8.9	30.5	--	100.0
Thailand	--	9.1	--	--	12.4	14.7	[1] 1.7	9.7	--	100.0
Brazil	9.9	0.9	--	18.6	0.9	--	6.3	1.4	0.1	100.0
Greece	11.1	5.0	--	--	13.4	--	8.4	--	--	100.0
Group II										
Iran	22.0	0.4	0.9	0.8	-0.8	--	23.5	--	--	100.0
India	--	0.7	--	2.1	1.2	0.2	4.8	2.7	--	100.0
Poland	12.1	--	--	--	2.7	--	--	--	--	100.0
Argentina	38.3	--	--	--	2.5	--	1.6	--	0.9	100.0
Chile	--	--	--	--	0.2	--	--	--	--	100.0
Japan	28.5	--	--	3.0	5.2	--	--	--	--	100.0
Spain	61.0	37.3	0.3	--	--	--	0.3	--	--	100.0
Colombia	8.9	--	--	40.7	1.4	--	17.2	0.2	--	100.0
Nigeria	3.5	0.2	0.7	21.8	0.4	6.9	3.7	--	--	100.0
UAR	21.2	--	--	--	--	--	9.5	--	--	100.0
Pakistan	--	--	--	--	3.7	--	10.3	1.9	--	100.0

[1] Includes cottonseed.

Some crops which account for sizeable increases in agricultural production in rapid-growth countries can also be adapted to and extensively grown in slow-growth countries. Therefore, the differences between slow-growth and rapid-growth countries may lie less in differences in the kind of crops they can grow than in differences in other factors. The substantial progress made in such countries as Sudan, the Philippines, Taiwan, Mexico, and Costa Rica indicates that careful consideration needs to be given to the role of public action at national, state, and local levels in increasing farm production incentives, freeing the energies and powers of decision of farm people, and providing an infrastructure of facilities and services. The aggressiveness and effectiveness with which countries compete for a share of world markets must also be considered in this context.

Change in Crop Yields

Change in yields per unit of land is now the best available indicator of changes in resource productivity for underdeveloped countries. Crop yields have increased since 1948 in all of the study countries. Generally, countries with above-average rates of increase in value of total crop production have also had higher than average rates of increase in crop yields (tables 9, 11, and 12). Leaders in yield increases include Israel, Sudan, Mexico, Taiwan, Greece, Yugoslavia, and Thailand. Among the more rapid-growth countries, only Brazil, Tanganyika, Venezuela, the Philippines, and Turkey have failed to achieve substantial yield increases. These countries have brought considerable areas of new land under cultivation, some of which may have been of low quality.

Table 11.--Indices of crop output per unit of land, 26 study countries, 1948-63

(1957-59 = 100)[1]

Area and country	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
	Percent															
Latin America																
Argentina	90	92	88	95	95	97	103	95	95	95	102	103	101	107	113	111
Brazil	101	96	100	101	99	98	99	98	94	100	99	101	103	107	106	NA
Chile	91	85	74	78	84	91	93	96	95	94	107	91	92	99	96	104
Colombia[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Costa Rica[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mexico	76	83	80	81	81	82	93	99	94	101	103	96	108	103	108	104
Venezuela	([3])	([3])	([3])	([3])	([3])	88	92	98	98	100	98	103	91	100	101	NA
Africa																
Nigeria	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sudan[4]	58	66	71	78	98	80	97	104	116	94	103	102	96	131	112	NA
Tanganyika	62	67	70	71	81	71	74	98	97	95	102	103	104	104	106	105
Tunisia[4]	82	169	169	95	147	133	102	108	94	94	105	102	88	62	127	125
Europe																
Greece	64	73	68	72	69	85	80	89	82	104	98	98	93	96	104	NA
Poland[4]	80	82	92	79	84	86	92	89	99	100	99	101	110	127	111	125
Spain	76	69	74	97	93	77	97	90	91	97	98	105	94	100	NA	NA
Yugoslavia	NA	NA	56	84	52	84	69	81	68	104	80	116	109	92	97	109
Near East and So. Asia																
UAR	94	93	88	84	97	87	91	88	88	97	99	104	108	93	111	111
India	104	91	93	88	88	89	97	99	95	99	94	106	102	114	112	109
Iran	68	89	96	79	88	92	93	90	92	99	100	102	98	103	99	107
Israel	NA	55	45	33	59	60	75	70	92	106	95	99	93	98	125	117
Jordan	144	158	116	119	152	81	158	73	139	143	43	114	81	109	76	37
Pakistan	97	100	96	99	95	96	99	96	92	102	100	98	102	108	110	108
Turkey	92	79	96	112	114	119	89	99	92	103	100	97	103	96	101	115
Far East																
Japan	88	83	84	82	88	76	82	101	92	96	99	105	109	108	114	110
Philippines	90	97	97	106	107	108	115	108	102	100	102	98	106	103	112	114
Taiwan	65	73	78	77	81	89	90	88	94	98	102	101	102	107	NA	NA
Thailand	91	90	88	92	93	100	84	99	108	98	103	99	118	117	116	NA

[1] Changes result from combined influence of changes in crop patterns and in crop yields.
[2] Due to severe deficiencies in data on land area, series on yield have not been calculated.
[3] Data incomplete or not available.
[4] Data for 6 annual crops.

Table 12.--Classification of countries by rates of increase in area of crops and crop yields, 24 study countries, arrayed by 1948-63 rate of increase in crop production

Country	Annual rate of increase in crop output	Countries in upper half of distribution by increase in area of crops and in--		Countries in lower half of distribution by increase in area of crops and in--	
		Upper half of increase in yields	Lower half of increase in yields	Upper half of increase in yields	Lower half of increase in yields
	Percent				
Israel	9.7	x			
Sudan	8.0	x			
Mexico	6.3	x			
Philippines	5.2		x		
Tanganyika	5.2		x	x	
Yugoslavia	5.1			x	
Taiwan	4.5				
Turkey	4.5		x		
Venezuela	4.5		x		
Thailand	4.4	x			
Brazil	4.2		x		
Greece	3.7			x	
Iran	3.6		x		
India	3.1		x		
Poland	3.0			x	
Argentina	2.8				x
Chile	2.8				x
Japan	2.8			x	
Spain	2.7			x	
Colombia	2.6			x	
UAR	2.0				x
Pakistan	1.8				x

Yield-Increasing Methods

It is not possible here to indicate quantitatively the resource basis of the observed increases in output per unit of land, except in Greece. The most important methods of effecting these increases have been shifts to irrigation farming and increased use of fertilizers, pesticides, and improved seeds. Increases in land under irrigation have particularly accounted for Mexico's output gains; in Israel, all increases in farmed areas consist of land brought under irrigation; and irrigation is similarly responsible for the gains made by Sudan. Sudan and Israel are examples of countries where increases in land area under cultivation and increases in yields commonly occur together. In these areas, irrigation often increases output per unit of land by making multiple cropping economically feasible. Moreover, placing land under irrigation is commonly associated with increased dependence upon the market economy and with increased use of purchased inputs, such as fertilizers, pesticides, and improved seeds, as well as with improved tillage practices.

Estimates for Greece between 1950 and 1960 ascribe about 8 percent of the increases in crop production to increases in land area and 92 percent to changes in output per unit of land (table 13). Bringing land under irrigation was the most important factor in these increases (33 percent).

Table 13.--Estimated contribution of selected factors to the increase in crop production, Greece, 1950-60

Factor	Contribution	Factor	Contribution
	Percent		Percent
Land[1]	7.6	Other[4]	42.2
Irrigation[2]	33.1		
Fertilizers[3]	17.1	Total	100.0

[1] Assuming the average "productivity" of land remained the same.

[2] Assuming yield of land irrigated was 3.3 times that not irrigated. Based on information in C. Evelpidis, "Irrigation in Greece," Internatl. Jour. Agrarian Affairs, Oxford Univ. Press, London, Jan. 1963. The land factor in irrigation (as a result of increasing amounts of land under irrigation) was removed in the computation.

[3] Assuming a 33-percent increase in yields for each 60 kilograms of fertilizer used; based on 1959 FAO Mission report on Greece.

[4] Technical improvements, such as better seed selection, crop rotation, use of pesticides, etc.

In most of the study countries, yield increases on other than newly irrigated land have apparently been achieved by adoption of simple, yield-increasing improvements involving little if any additional cash expenditures. In most countries, increases in uses of purchased inputs have been too small for these to have accounted for more than 30 to 50 percent of the yield increases observed since 1948--even assuming quite high responses for such inputs (see Chapter 5).

At early development stages, cheap sources of yield increases are probably available to farmers in most study countries. These cheaper sources include shifts to row planting of cotton, maize, rice, and many crops now grown broadcast; better weed control; improvements in other tillage practices; and increased timeliness and care in crop harvesting. Exploitation of such sources can increase the farmer's capacity to finance more costly sources of output increases.

The supply of relatively cheap sources of yield increases can be appreciably expanded through research. Variety improvements have been one of the cheaper new sources of yield increases produced in the United States, Mexico, Japan, and some other countries through research. Similar research is still in the infancy stage in most of the world's underdeveloped countries.

CHAPTER 3.--LAND AND OTHER NATURAL FEATURES

The productivity of land for agricultural uses is increasingly becoming a function of advances in agricultural technology and of the greater capital and skills technology requires. Thus far, scientific and engineering research has been heavily concentrated in a few economically advanced countries such as the United States, Germany, and Japan. For this reason, natural resource differences are important at early stages of development. Differences in the natural resource bases of underdeveloped countries may account significantly for differences in their agricultural output and short-run growth potentials. This importance will likely decline as progress is made in agricultural technology.

Agricultural Land Area and Expansion Potentials

Soil surveys suitable for agricultural planning exist principally for economically advanced nations. Among the study countries, soils have been mapped in detail on a country basis only in Japan and Israel. They have been mapped for broader interpretations in some provinces of Greece, Yugoslavia, Taiwan, the Philippines, Tunisia, Venezuela, Colombia, Chile, Brazil, and Nigeria (Kellogg, 30).[2] Knowledge of soil resources for other study countries is extremely scanty.

Because of these limitations in knowledge of soils, World Soil Maps have been used for rating the study countries according to their agricultural land expansion potentials (table 14). These maps delineate broad soil groups on a country basis for 23 of the study countries.

Estimates of the amount of potentially arable land in each country are based on the world average potential for each soil group as shown in table 15; in the case of alluvial soils, estimates are based on the assumption that 50 to 80 percent are potentially arable (fig. 6). Such estimates obviously do not take account of intercountry differences in the soil groups. Neither do they account for the cost of bringing new lands into arable farm uses relative to their productivity. More importantly, they do not consider moisture limitations. At best, therefore, such estimates must be taken as long-run expansion potentials whose economic feasibility will depend upon growth in needs for food, initial costs of bringing such lands into use, technological advances, and even prospects of increasing output on land now in use.

Potentials for expansion of the arable land area in terms of area alone are relatively large in Brazil, Colombia, Venezuela, Argentina, Tanganyika, Sudan, and Iran. If we disregard immediate economic feasibility, these countries could expand their arable land area by 75 percent or more. Economic feasibility of such expansion under present conditions is probably very low in countries as Iran and Sudan because of moisture limitations. Both of these countries have sizeable areas where sufficient water could make the soils productive. Some of the potentially arable land will require modern machinery, relatively large amounts of fertilizers, drainage, and irrigation before it can be made highly productive.

Potentials for expanding arable land area are lowest (under 25 percent) in the Philippines, Japan, Taiwan, Tunisia, Poland, India, Israel, Yugoslavia, Greece, and Turkey. Since 1948, Turkey has plowed up much of the land that should have been left for grazing.

Estimates of arable land expansion potentials range from 25 to 75 percent in Chile, Mexico, Thailand, and Egypt. Water limitations make this estimate almost meaningless for Egypt.

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[2] Underscored numbers in parentheses refer to items in the Bibliography, p. 122.

Table 14.--Selected statistics on land expansion potentials of study countries, selected years

Country	Year	Arable land expansion potentials	Total land now in arable use	Country	Year	Arable land expansion potentials	Total land now in arable use
		Rating[1]	Percent			Rating[1]	Percent
Brazil.....	1957	I	2	Japan.....	1960	IV	16
Sudan.....	1954	I	3	Philippines..	1961	IV	23
Tanganyika...	1960	I	10	Taiwan.....	1960	IV	22
Colombia.....	1960	I	4	Tunisia.....	1957	IV	38
Venezuela....	1960	I	3	Poland.....	1961	IV	53
Argentina....	1957	I	11				
Iran.....	1960	II	10	India.....	1958	IV	49
				Israel.....	1961	IV	20
UAR.....	1961	III	3	Yugoslavia...	1960	IV	32
Thailand.....	1960	III	20	Greece.....	1960	IV	28
Chile.....	1956	III	8	Turkey.....	1961	IV	32
Mexico.....	1950	III	10				

[1] The ratings I, II, III, and IV indicate increases in land expansion over area now in use of more than 150 percent, 75-149 percent, 25-74 percent, and under 25 percent, respectively.

Table 15.--Estimates of potentially arable land in the world, by soil groups

Soil groups	Percentage potentially arable	Area potentially arable
	Percent	Mil. acres
1. Prairie soils, degraded chernozems.....	80.0	242
2. Chernozems and reddish chestnut.....	70.0	660
3. Dark gray and black soils of subtropics and tropics.....	50.0	618
4. Chestnut, brown, and reddish brown.....	30.0	892
5. Sierozems, desert.....	.5	34
6. Podzols and weakly podzolized.....	10.0	320
7. Gray-brown podzolic.....	65.0	972
8. Latosols, red-yellow podzolics.....	35.01	2,780
9. Red-yellow mediterranean.....	15.0	41
10. Soils of mountains.....	.5	30
11. Tundra.....	.0	0

Source: Adapted from Kellogg (30).

Significantly, expansion in area of crops has been an important source of crop output increases mainly in those countries with a large land expansion potential (tables 8 and 14). However, land expansion potential must not be mistaken for agricultural output expansion potentials. For example, Japan's agricultural output in 1960 was $961 per hectare of arable land, compared with only $91 for India and $78 for Argentina. These comparisons indicate much more fully than do land expansion potentials the magnitude of the agricultural output expansion potentials in less-developed countries.

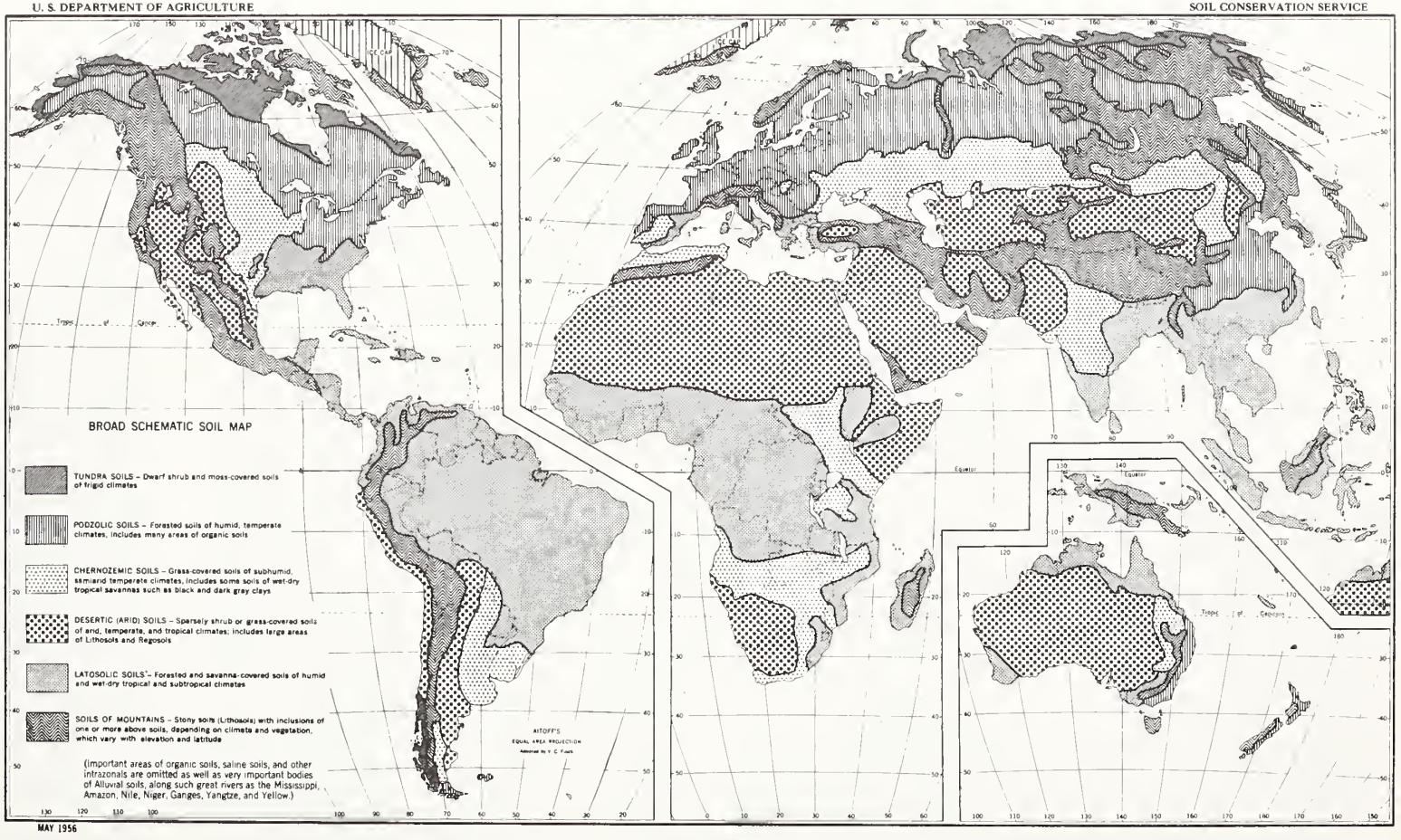

Figure 6.--Map of the world showing six broad soil zones. Each of these has generally similar processes of horizon differentiation prevailing over it. These are reflected in the character of the well-drained soils with undulating to the rolling topography. Many kinds of soils in addition to the dominant ones are present in every zone.

Differences in Quality of Soil Resources

The worth of soils for agricultural uses can vary greatly among countries, depending upon the country's fund of technological knowledge, and the conditions affecting supplies and prices of other production factors and the demand for agricultural products. In terms of their physical productivity when first plowed or while technology is still in a rudimentary stage, the world's major soils have been classified as follows:

Most favorable: Prairie soils; degraded chernozems; chernozems; reddish chestnut soils; gray-brown podzolic soils; alluvial soils.

Moderately favorable: Dark gray and black soils of the tropics and subtropics; sierozem soils; desert soils; chestnut soils; brown soils; and reddish-brown soils.

Fairly favorable: Latosolic soils: red-yellow podzolic soils; red-yellow mediterranean soils; podzols.

The "most favorable" category includes the best soils found in temperate areas and alluvial soils in both temperate and tropical climatic zones. "Moderately favorable" includes mediocre soils of temperate climates and some of the better soils of the tropics. "Fairly favorable" includes the least responsive of tropical and temperate climate soils.

Countries with more than 65 percent of their potentially arable soils in the most favorable group are rated "1". Countries with less than 65 percent of their potentially arable soils in the most favorable category, but with 75 percent in the most favorable and moderately favorable categories combined are rated "2". Other countries are rated "3".

It is not surprising that countries having the highest ratings generally rank lowest in their arable land expansion potentials (tables 16 and 17). Argentina is an exception.

Table 16.--Ratings on quality of potentially arable land and potential for expansion, 21 study countries[1]

Country[2]	Quality of potentially arable land[3]	Arable land expansion potential[4]	Country[2]	Quality of potentially arable land[3]	Arable land expansion potential[4]
	Rating	Rating		Rating	Rating
Greece	1	IV	Sudan	2	I
UAR	1	III	Iran	2	II
Yugoslavia	1	IV	Chile	2	III
Taiwan	1	IV			
Poland	1	IV	Japan	3	IV
Argentina	1	I	Thailand	3	III
Turkey	1	IV	Venezuela	3	I
			Tanganyika	3	I
Mexico	2	III	Philippines	3	IV
Tunisia	2	IV	Brazil	3	I
India	2	IV	Colombia	3	I
Israel	2	IV			

[1] Ratings of 1, 2, and 3 indicate most favorable, moderately favorable, and least favorable, respectively.

[2] Groupings are based on quality of potentially arable land.

[3] From standpoint of adaptation of productive crop culture with current world knowledge of agricultural techniques.

[4] See footnote 2, table 14.

Table 17.--Expansion and quality ratings of soil resources in representative countries

Country	Expansion rating	Soil quality	Reasons
Yugoslavia.	3	1	Expansion: Yugoslavia's current arable land amounts to 30 percent of the nation's total area. This is about equal to Yugoslavia's maximum potential arable land under good soil management practices. Over half of the country's soils are not suitable for agricultural production or are suitable only for sparse grazing. Many unsuitable soils currently are being used and erosion is resulting. Quality: Of soils potentially arable under good soil management practices, Yugoslavia has a high proportion of very productive types. Black, loamy chernozem soils, fertile brown forest soils, moderately leached gray-brown podzolics, and drained alluvial soils make up the bulk of the country's arable soils.
Tunisia....	3	2	Expansion: As Tunisia is an arid country, water is the foremost barrier to expansion of arable land. But, even if all of Tunisia's known water resources were exploited, only a small addition would be made to currently arable land. Quality: Soil of oases make up an important part of the country's arable land. Centuries of manure and water have made these soils highly productive. Alluvial soils and the deeper desert soils are moderately productive in northern Tunisia where rainfall is highest.
Colombia...	1	3	Expansion: Current arable land in Colombia is under 10 percent. Perhaps one-fifth of the country is potentially arable. So, although agricultural production is undesirable on over half of the land (primarily because of steep, shallow mountain soils), a substantial opportunity for expansion remains. Quality: Most of Columbia's potentially arable soils are latosols. These soils have rarely supported a highly productive agriculture.
Thailand...	2	3	Expansion: About one-fifth of Thailand is currently arable land, and about one-third of the country's land seems potentially arable. Quality: Alluvial soils and latosols each constitute somewhat less than 50 percent of Thailand's potentially arable soils. The bulk of the difference is dark tropical clays. Thailand's alluvial soils are highly productive with irrigation, fertilizer, and drainage. Sandy ferruginous latosols are very infertile but can be used for wet rice. The dark tropical clays are productive but become very sticky when wet and extremely hard when dry.
UAR.....	2	1	Expansion: Egypt currently uses only 3 percent of its land area for agricultural production. Virtually all of this is arable land. Compared to current use, large amounts of good soil remain unexploited. Water is the main limiting factor. Estimates of potential arable land must be based on assessment of water resources. With large water reserves under the desert, perhaps an additional 2 percent of total land area can be brought into production. Quality: Nearly all Egypt's arable land is fertile alluvial soil irrigated from the Nile.

In a developing world, technical knowledge and capital to invest in land development activities crucially affect soil productivity. In some cases, drainage makes formerly unusable soils highly productive. Deep plowing may turn previously unworkable clay soils into high-yielding land. But usually, high productivity results from a combination of techniques and inputs. The cultivation system has to be modified to overcome the limitations and enhance the potentials of a given soil and the environment in which it is found. Plant varieties and fertilizers can be adapted to suit best the peculiarities of a soil type.

Most of the fundamental research in soil sciences has been done in developed countries (Ignatieff, 28). These countries are nearly all in the temperate regions of the world. Most underdeveloped countries, and certainly the more impoverished ones, are in tropical regions.

In their natural state, tropical soils can support tremendous quantities of vegetable matter per hectare. However, these soils do not have a large reserve of fertility. Plants of tropical forests thrive on the heat and humidity, but the soil has only a thin layer of humus. Organic matter decomposes rapidly under tropical conditions; hence, new plants are nourished by recently fallen plants. When forests are cleared, the humus layer may completely disappear because of lack of new organic matter.

High temperatures and rainfall encourage loss of soil nutrients from the root zone. Since the soil water is warm, it can hold large amounts of nutrients in solution. Heavy and intense rainfall washes the nutrients in solution out of the reach of all except the most deeply rooted plants.

In areas with dry seasons, water of the subsoil may return to the root zone, carrying with it metallic hydroxides which form a sterile, impermeable layer known as laterite (Gourou, 23). Laterization becomes more acute as the dry season lengthens; consequently, it is progressively more common as one goes from the equator towards large desert regions.[3]

Aside from intense leaching, tropical rainfall causes severe erosion, as much because of its distribution as because of its quantity. Tropical rain tends to come in cloudbursts, with rain falling for 20 to 40 minutes at the rate of 3 inches per hour.

Tropical climate imposes yet another obstacle. As one moves toward desert regions, rainfall becomes progressively more erratic. Moreover, the rainy season changes from year to year. More importantly, the distribution pattern is less predictable, and so complicates soil management problems. The first rains may be followed by a severe dry period, or most of the season's rain may fall at the beginning, or alternatively at the end, of the wet season.

Shifting agriculture was primitive man's approach to the vagaries of tropical soil and climate; it has continued as a successful means of survival for hundreds of generations. The farmer disturbs the balance between vegetation and soil as little as possible by carving only small patches out of the forest and by incomplete clearing. He interplants a variety of crops to provide foliage protection through the growing season and to hedge against weather. Nonetheless, fertility under shifting cultivation declines rapidly, and, after about three seasons, the land is left fallow for 10 or 20 years to regain its fertility. Thus, shifting agriculture keeps man only one step ahead of complete disaster. As population increases, farmers are shortening the fallow periods at the cost of declining yields and more erosion. The system is incapable of supporting dense populations.

Highly productive agriculture, however, has been developed on some tropical soils. This has been most often associated with tree and other perennial crops, such as coffee, rubber, oil palm, bananas, and cocoa. Tree crops minimize soil exposure, and deep tree roots utilize plant nutrients washed down from the surface.

Where water management is economic, wet rice culture appears to be successful in the wet tropics in feeding dense populations. Although wet rice cultivation can solve the

[3] According to USDA soil scientists, laterite may not be quite as hazardous as some believe. The cultivators of Kerala State in India somehow learned how to handle these soils over a thousand years ago. They learned how to grow food crops in mixed cultures without plowing.

problem of increasing densities of population, it merely forestalls a decline in labor productivity. It can, however, absorb increased numbers of cultivators on a unit of cultivated land (Geertz, 22, p. 32). An additional laborer in the paddy can perform an additional painstaking practice which will produce enough for his own support.

The rice paddy is one important way of overcoming the limitations of tropical soils. Flooded ricefields can annually produce enough carbohydrates with a minimum of manure; also, they can be cultivated without fallow periods, risk of erosion, or exhaustion of the soil (Gourou, 23, pp. 94-5). Other ways of using and improving tropical soils can probably be developed through experimentation. Although these soils are inherently less productive than temperate soils, the greatest barrier to increased agricultural productivity in the tropics is lack of fundamental agricultural research.

Rapid increases in crop production in the 1948-63 period tended to occur in countries which expanded their cultivated acreage substantially (table 18). Yet the increase in area of crops was not closely related to the potential for arable land expansion.

Table 18.--Selected production factors related to land characteristics, 21 study countries

Country	Annual rate of change in crop output[1]	Potential for arable land expansion	Quality of arable land[3]	Per capita gross domestic product, 1960[4]	Change in area of field crops, 1948 to 1963[5]
Group I	Percent	Rating[2]	Rating[2]	U.S. dollars	Percent
Israel.....	9.7	4	2	905	68.5
Sudan.....	8.0	1	2	66	49.9
Mexico.....	6.3	3	2	321	49.7
Philippines.....	5.2	4	3	113	66.9
Tanganyika.....	5.2	1	3	57	58.8
Yugoslavia.....	5.1	4	1	179	6.8
Taiwan.....	4.5	4	1	97	11.7
Turkey.....	4.5	4	1	254	62.0
Venezuela.....	4.5	1	3	650	54.0
Thailand.....	4.4	3	3	84	29.5
Brazil.....	4.2	1	3	145	54.6
Greece.....	3.7	4	1	297	22.3
Group II					
Iran.....	3.6	2	2	130	38.6
India.....	3.1	4	2	70	26.0
Poland.....	3.0	4	1	538	-0.9
Argentina.....	2.8	1	1	465	2.7
Chile.....	2.8	3	2	405	14.0
Japan.....	2.8	4	2	337	0.9
Colombia.....	2.6	1	3	248	3.1
UAR.....	2.0	3	1	155	11.5
Tunisia.....	1.6	4	2	145	6.2

[1] From Chapter 2.

[2] Ratings are those shown in table 14.

[3] From the standpoint of adoption of productive crop culture with current world knowledge of agricultural techniques. Data are from table 16.

[4] From table 67.

[5] From table 9, Chapter 2.

Recent agricultural development patterns in the study countries indicate the possibility of rapid increases in output, even in countries with meager land resources. An abundance of land resources does not by itself insure development. Development depends upon what is done with available land resources, including improvement in technical possibilities, sources of supply of other production requisites, knowledge and skills of farm people, and incentives to producers as affected by price policies, tenurial arrangements, and other institutional factors.

Climate

Tropical climates favor insect multiplication (Gourou, 23). Fairly constant temperatures and high humidity throughout the year make insect control far more serious in the tropic than in temperate climates where low winter temperatures help keep insects in check. Likewise, warm humid climates encourage the multiplication of micro-organisms. Perishability, another severe problem in the tropics, is one of the major hindrances to the development of commercial horticulture and animal production. The one advantage of tropical climate lies in the possibility of multiple cropping where water is available.

Water Resources

Irrigation has long been the basis of agricultural development in arid regions. In many other countries, it compensates for poorly distributed rain during the growing season.

Knowledge of the amount of currently irrigated land is quite imprecise (Garnier, 21). What passes for irrigation in one country is not treated as irrigation in others. For example, in some countries rain-fed rice paddies and cropland watered by annual floods are considered irrigated. It is also difficult to obtain satisfactory statistics for any given level of irrigation, especially in a country where some farmers use wells and some streams, and where the amount of water used differs greatly from farm to farm.

Irrigation data for various countries for around 1955 are indicated in table 19 and for 1960 in table 20. Because of changes in definition of irrigated land, however, data for the two time periods are not highly comparable.

In Egypt, virtually all cultivated land is irrigated because the country lacks significant rainfall. Irrigated land is a small proportion of cultivated land in other arid countries where there is enough rainfall during at least part of the year. Furthermore, few arid countries have a potential source of irrigation that approaches the Nile. Often, arid countries find that the most efficient use of meager water resources is to save the water for livestock and let the livestock graze the vegetation that grows during the rainy season. This is in addition to raising crops during the rainy season.

The importance of irrigation in a country's agriculture does not depend wholly on its climate. Egypt would be essentially uninhabitable without irrigation, but as already noted, other arid countries are able to provide food and fiber without it. In fact, irrigation tends to be most important in countries with moist climates where, presumably, rainfall is adequate for most crops. Rice growing is common to most countries where irrigation is utilized extensively. Much rice is grown in rain-fed paddies; such paddies are usually considered as irrigated. Higher yields result when water control is more precise as when it is transferred from a natural source to agricultural land by irrigation.

Table 20 shows maximum potential for irrigation in a few of the study countries. Significantly, countries which have some idea of their water resources are the most developed. Few underdeveloped countries have conducted surveys which indicate their irrigation potential. Furthermore, few countries have begun to approach utilization of all their available water resources. One exception is Israel, which may be using essentially all its available water by 1970.

Table 19.--Extent of irrigated land in 23 study countries, circa 1955

Country	Area irrigated[1]	Ratio of irrigated to cultivated land	Country	Area irrigated[1]	Ratio of irrigated to cultivated land
	1,000 acres	Percent		1,000 acres	Percent
Israel.....	110	11.2	Iran.....	5,000	--
Sudan.....	1,523	20.7	India.....	59,057	19.9
Mexico.....	5,330	9.2	Argentina.....	2,500	3.3
Philippines....	1,450	14.8	Chile.....	3,212	20.4
Tanganyika.....	--	--	Japan.....	9,430	75.6
Yugoslavia.....	153	0.8	Spain.....	863	3.8
Taiwan.....	1,337	61.8	Colombia.....	208	3.5
Turkey.....	217	0.6	UAR.....	7,000	100.0
Venezuela.....	77	1.0	Pakistan.....	21,310	47.4
Thailand.....	2,184	16.3	Tunisia.....	124	1.3
Brazil.....	346	0.1	Jordan.....	72	--
Greece.....	474	5.9			

[1] Land in which 2 irrigated crops are raised per year are counted twice.

Source: International Commission on Irrigation and Drainage, Irrigation in the World, New Delhi, 1955.

Table 20.--Irrigated land in 18 study countries, 1960, and planned increases and potential for irrigation

Country	Year	Irrigated land[1]	Ratio of irrigated to cultivated land	Planned increases in irrigated land	Estimated irrigated potential as percentage of cultivated land
		1,000 acres	Percent	1,000 acres	Percent
Israel.....	1960	334	31.1	--	54.0
Sudan.....	1963	2,000	--	200	--
Mexico.....	1964	10,600	--	3,000	--
Costa Rica.....	(recent)	37	5.3	--	--
Yugoslavia.....	1960	297	1.4	--	35.9
Venezuela.....	1963	642	5.0	--	--
Brazil.....	1963	865	1.8	--	--
Greece.....	1960	899	10.3	--	32.3
India.....	1959	58,000	20	35,000	44.0
Poland.....	1961	514	1.3	--	14.5
Argentina.....	1963	2,772	3.7	--	--
Chile.....	1963	3,370	24.7	1,200	--
Japan.....	1960	8,500	57.0	--	--
Spain.....	1960	4,524	8.6	--	21.2
Colombia.....	1963	544	4.3	--	--
UAR.....	(recent)	7,000	100	[2] 2,000	--
Pakistan.....	1963	27,400	37.7	--	--
Tunisia.....	1962	151	--	--	([3])

[1] Land with irrigated crops. Multi-cropped land counted only once.

[2] From Nile only.

[3] Maximum potential estimated at 140,000 acres.

Source: Elco Greenfields, "Water Has a Key Role," Farmer's World, The Yearbook of Agriculture, 1964, Washington, D. C.

CHAPTER 4.--LAND TENURE AND SIZE OF HOLDINGS

The relationships among people which determine their rights to the occupancy and use of land are exceedingly important in societies where land represents the main occupation of the population. Power to control its use is also power to control the lives of the people who must use it. It is no mere coincidence, therefore, that during most of recorded history land tenure systems have been intimately linked to political power structures and social class lines.

The land tenure system defines social class relations more fully than does any other institution in most of the world's agrarian countries; it controls or at least limits the power of choice and action of individuals and families; it is the chief means of rationing economic opportunity; and it determines the interpersonal distribution of production and income, and the extent to which general economic incentives become meaningful to the farm people. [4]

For many, the vast importance of tenure relations for the agricultural development of underdeveloped countries has probably been obscured by observation of recent agricultural progress in the United States under each of several kinds of tenure. The United States, however, is an economically advanced country, and land is no longer its main source of economic opportunity. With this decline have come significant changes in the role of land in the Nation's social and political life. Increasingly, the relationship between tenants and their landlords has become one between businessmen who are near equals in their economic, social, and political influence. Increasing alternatives outside of agriculture have increased the bargaining power of tenants; given them large freedom of choice; insured them earnings that are reasonably commensurate with their contributions to output; and helped to insure price incentives which fully reflect prices as expressed in general markets.

Land tenure patterns vary both among and within the study countries. In some countries, the dominant tenure system is one of nearly unlimited private ownership of land, with owners relatively free to use, rent out, or sell their land. In a few countries, land is held mainly under communal ownership. These patterns are deeply rooted in tradition and custom, and have been devised to meet needs of a traditional subsistence economy. Individual users have no alienable rights and only limited rights of a long-term nature. In still other cases, landownership is vested in the state. Among countries permitting private ownership of land, some have a wide distribution of ownership and others have large concentrations of landownership.

Comparative data now available on tenure patterns in the study countries, however, are limited mainly to those on number of holdings and associated land area by tenure. These patterns are categorized as "owner-operated," "fixed-rent," "crop share renter," and "other forms of tenure" (tables 21 and 22). What each of these categories means in terms of tenurial rights varies greatly among countries. In some, ownership rights are fairly comparable to those held by fee-simple owners in the United States. In others, ownership is limited with respect to size of land holdings and alienation rights. In some countries, owners may be but "tenants of the king," paying an exorbitant share of their output in taxes. Tenants may have rights closely approximating those of the owners, or they may be little more than serfs. The latter condition has been most prevalent in countries with large concentrations of landownership, where sometimes a single landlord owns the lands occupied and used by hundreds of villages. In such situations, the landlord has a monopoly over land resources and near absolute power over the lives of his tenants.

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[4] For a fuller and more penetrating analysis of the interrelations between land tenure and social and political power structures, see Parsons, Kenneth H., "Agrarian Reform Policy as a Field of Research," Agrarian Reform and Economic Growth in Developing Countries. U.S. Dept. Agr., Econ. Res. Serv., Mar. 1962.

Table 21.--Percentage distribution of number of holdings by tenure, 16 study countries, selected years

Country	Year	Percentage distribution of number of holdings by tenure (excluding mixed holdings)--					Annual compound rate of change in total crop output, 1948-63
		Owner-operated	Rented			Other forms of tenure	
			Fixed rent	Crop share	Total		
		Percent					
Israel	1950	42	4	1	5	53	9.7
Mexico	1950	68	2	1	3	29	6.3
Costa Rica	1950	91	2	2	5	4	5.6
Philippines	1948	58	1	29	[1] 42	--	5.2
Taiwan	1962	65	--	--	14	[2] 21	4.5
Venezuela	1950	42	15	6	21	37	4.5
Thailand	1950	83	--	--	17	1	4.4
Brazil	1950	--	--	--	9	10	4.2
Greece	1950	96	2	1	3	1	3.7
Iran	1960	34	12	44	56	10	3.6
Chile	1955	--	--	--	--	--	2.8
Japan	1950	92	--	--	7	1	2.8
	1960	75	--	--	3	22	--
Argentina	1952	41	--	--	23	36	2.8
UAR	1950	76	--	--	24	--	2.0
Pakistan	1960	54	--	--	17	29	1.8
Jordan	1953	95	--	--	5	--	1.9

[1] Fixed rent and crop share do not add up to the total because of other ways of renting.
[2] Part owner.

Source: Land Tenure: World Agricultural Structure, Study No. 2, FAO, Rome, 1961, and other data provided by FAO.

Large concentrations of landownership are typical in many less-developed areas of Latin America, the Middle East, and Asia, where the tenure system has become deeply involved in economic, political, and social inequality. These are areas in which tenure problems are creating strong pressures for land reform. Such pressures helped to set off the Mexican revolution 50 years ago; this was essentially a peasant revolt in a predominantly subsistence economy which paved the way for the establishment of a representative government and recent high rates of economic growth. The ejido form of tenure of the revolutionary era has been supplemented by privately owned, medium-sized farms in irrigated areas. In Egypt, the aim of the recent land reform has been to limit the relatively few persons who had great economic power prior to 1952.

The importance of land reform has been widely recognized since the end of World War II. Several of the study countries have given prominence to land reform measures in their development programs. Some have achieved striking progress in this field, notably Taiwan, Egypt, and Iran.

The difficulty of establishing a definitive statistical relationship between tenure patterns and recent agricultural progress is complicated further by the heterogeneity of the study countries with respect to other variables influencing output. Most of those countries in which a large percentage of the landholders were owner-operators had average or above average increases in agricultural output. These include Costa Rica, Japan, Thailand, Greece, and Mexico, where two-thirds or more of the landholders were classified as owner-operators. Exceptions include Jordan and the United Arab Republic.

Table 22.--Percentage distribution of holding area by tenure, 13 countries, selected years[1]

Country	Year	Percentage of holding area by tenure					Annual compound rate of change in total crop output, 1948-63
		Owner operated	Rented			Other forms of tenure	
			Fixed rent	Crop share	Total		
		Percent					
Israel	1950	19	42	3	45	36	9.7
Costa Rica	1950	96	NA	NA	2	2	5.6
Tanganyika	1961	84	NA	NA	3	13	5.2
Venezuela	1950	83	4	2	6	11	4.5
Thailand	1950	90	NA	NA	10	--	4.4
Brazil	1950	89	NA	NA	11	--	4.2
Greece	1950	89	5	2	7	4	3.7
Iran	1960	26	7	55	62	12	3.6
Chile	1955	70	NA	NA	23	7	2.8
Japan	1960	82	NA	NA	1	17	2.8
Colombia	1960	75	NA	NA	9	16	2.6
UAR	1950	69	NA	NA	31	--	2.0
Pakistan	1960	47	NA	NA	24	29	1.8

[1] Data not available for Sudan, Mexico, the Philippines, Yugoslavia, Taiwan, Turkey, India, Poland, Argentina, Spain, Nigeria, Tunisia, and Jordan.

Source: Same as table 21.

In the United Arab Republic, the possibly salutary effect of recent land tenure reforms upon agricultural production may have been obscured by increasing pressure of population on land. In Jordan, there appears to have been a discrepancy between the legal and economic concepts of owners because of the reallotment of land every few years under that country's Musha tenure system.

Iran, Argentina, Israel, and Pakistan have relatively high percentages of tenancy. In Israel, rented land is mostly state owned. It was initially rented to immigrants and others on leases of 5 years' duration, pending the granting of leases with heritable rights. Land tenure reform in Iran has been officially recognized by Iranian leaders as one of the major requirements for its entry into the ranks of rapidly developing nations.

Innumerable systems of land tenure are known to exist in Nigeria and Tanganyika. Most commonly, however, land is held by a group of people, usually a tribe. It belongs not only to the living members of the tribe, but to past and future generations. Hence, neither the tribe nor individuals can permanently alienate it.

Rights to use land are established by investing labor in the land. The labor investment right applies especially to planted tree crops. Economic trees growing wild usually belong to the community as a whole, and their fruit to anyone willing to harvest it.

Individuals have the right to use the land but not to sell it or the appurtenances which they have developed. Generally, these restrictions on alienation limit both mobility and incentives to invest in land improvements.

Data comparing farms by tenure within countries are available for a few of the study countries--mainly Iran, the Philippines, and India. In Iran in 1960, crop yields per hectare were generally higher on land rented on a fixed rent basis and on owner-operated units than on land rented for a share of the product (table 23).

Table 23.--Iran: Crop yield per hectare of harvested area, by types of tenure, 1960

Crop	On lands rented from others for a share of produce	On lands owned by holders	On lands rented from others based on fixed rent
	Kg.		
Wheat total	735	883	931
Irrigated			
Winter	1,169	1,321	1,336
Spring	713	1,017	1,029
Unirrigated			
Winter	521	612	813
Spring	336	462	240
Barley total	680	798	1,244
Irrigated			
Winter	1,155	1,264	1,660
Spring	802	974	1,943
Unirrigated			
Winter	687	729	1,156
Spring	326	409	339
Rice	2,164	2,325	2,281
Legumes			
Irrigated	507	786	2,158
Unirrigated	363	513	1,051
Cotton			
Irrigated	1,007	1,302	1,744
Unirrigated	1,002	1,095	920

Source: First National Census of Agriculture, Iran (Oct. 1960), National Summary Report, Dept. of Public Statis.

In the Philippines, total farm receipts in 1954-55 per hectare were about 60 percent more on tenant farms than on owner-operated farms (table 24). However, the value of land per hectare is much larger on tenant farms than on owner-operated farms. This suggests that tenant-operated land was generally more fertile (table 25). In value of output per 100 pesos value of land, owner and part-owner farms compare favorably with tenant farms. The main crop on tenant farms is paddy, which requires much labor. The fact that tenants have a larger proportion of lowland paddy also indicates more double-cropping on tenant farms. On the other hand, land in coconut plantations, pastures, and meadows is more often worked by owners (table 26).

In India, farm management surveys in a few areas provide information on the intensity of land use and output by tenure system. In one of these areas, the West Godavari district of Andhra Predesh, the intensity of cropping is considerably higher on fully owned holdings than on rented land (table 27). Also, output per acre of irrigated paddy on fully owned holdings is much higher than on partially owned holdings (table 28). There is not much difference between fully owned and fully rented holdings.

It is difficult to make reliable generalizations from the above observations because of lack of information on differences between the tenure classes in other factors also associated with output and yields. The more favorable showing of tenant farms in some of the above comparisons probably reflects little more than the tendency for plantation types of agriculture, where tenancy is high, to be concentrated on the most fertile lands.

Table 24.--Value of farm production by types of tenure, Philippines, 1954-55[1]

Item	Per farm household			Per hectare of--		
	Owner farms	Part-owner	Tenant farms	Owner farms	Part-owner	Tenant farms
	Pesos					
Crops sold	374	356	206	129.0	118.7	85.8
Value of crops to landlord	--	293	426	--	97.7	177.5
Livestock and products sold	87	65	38	30.0	21.7	15.8
Value of crops and livestock used at home	299	310	285	103.1	103.3	118.8
Value of shares for services	95	146	178	32.8	48.7	74.2
Total	855	1,170	1,133	294.8	390.0	472.1

[1] Average hectares per farm were 2.9 for owners, 3.0 for part-owners, 2.4 for tenants, and 2.6 for all tenure classes combined.

Source: Farm Management, Land Use and Tenancy in the Philippines. Central Expt. Sta. Bul. No. 1, Univ. Philippines, Aug. 1957, p. 70.

Table 25.--Value of land per hectare and farm receipts per 100 pesos of land value, Philippines, 1954-55

Tenure	Value of land per hectare	Farm receipts per 100 pesos of land
	Pesos	
Owner-operated farm	1,633	56
Part-owner farm	2,235	57
Tenant farm	2,767	58

Source: Same as table 24.

Table 26.--Percentage distribution of type of land, by tenure, Philippines, 1954-55

Land type	All operators	Owner	Part-owner	Tenant
	Percent			
Lowland rice field	56	36	44	67
Upland rice field	11	10	8	13
Coconut plantation	10	14	17	7
Orchard land	4	4	8	2
Other fields	13	18	16	10
Woods, pastures, and wasteland	4	14	4	1
Farmstead	9	4	3	--
Total	100	100	100	100
Number of farms in the sample	5,344	1,103	880	3,361

Source: Same as table 24.

Table 27.--Operated area, cropped area, and intensity of cropping, by type of tenure, West Godavari District, India, 1957-58

Tenure	Operated area per holding	Cropped area per holding	Intensity of cropping
Paddy zone	Acres	Acres	Ratio
Fully owned.....	5.45	8.81	1.62
Partially owned.....	8.45	12.50	1.48
Fully rented.....	3.42	4.27	1.25

Source: "Studies in Economics of Farm Management in West Godavari District, Andhra Predesh, Report for the Year 1947-58," Andhra Univ. Walfair (p. 77).

Table 28.--Value of output per acre (of cropped area) according to type of tenure, West Godavari District, India, 1957-58

Tenure	Value of output
First-season crop	Rupees
Fully owned holdings.....	331.80
Partially owned.....	280.03
Fully rented.....	328.29
Second-season crop	
Fully owned	286.02
Partially owned.....	211.39
Fully rented.....	NA

Source: Same as table 27.

Relation of Size of Holdings or Farms to Output and Progress

Minute subdivision of operating units is a major obstacle to increasing output in several countries. Subdivision and fragmentation of holdings can prevail under any form of land tenure, but are most frequent in certain overpopulated areas cultivated by peasant owners where the rules of succession demand division of land. Islamic and Buddhist, and, to some extent, Hindu laws, demand division of land between the heirs of the deceased owner.

Relatively little is known about the effects of farm size on agricultural productivity, and even less about the economies of farm size in the developing countries. However, data are available for several countries which indicate how crop production per unit of cultivated area varied among farms of different sizes as measured in land area. In addition, a few farm management studies have treated size of farm as a variable.

In densely populated areas where labor has little or no opportunity cost, returns per acre above cash costs for purchased capital goods and services are an appropriate criterion for measuring the relative efficiency of different sizes of farms.

Much available evidence indicates that small family farms have higher gross output per acre than do large farms. For example, in a study of factors affecting the relative success of cooperative and family farms in the Punjab of India, Dr. Harbans Singh Mann found that production per acre generally was higher on small family-size farms than on the large cooperative farms (table 29). In the few instances where yields were higher on

Table 29.--Value of output per acre on cooperative and family farms in 10 areas, Punjab, India, 1953-54

Area	Value of output on--		Area	Value of output on--	
	Family farms	Cooperative farms		Family farms	Cooperative farms
	Rupees	Rupees		Rupees	Rupees
1.....	270	190	6.....	155	158
2.....	185	249	7.....	258	219
3.....	158	137	8.....	108	152
4.....	160	145	9.....	154	103
5.....	188	167	10.....	162	187

Source: Mann, Harbans Singh, Cooperative Farming and Family Farming in the Punjab: A Comparative Study. Ph.D. Thesis, Ohio State Univ., 1962.

the cooperative farms, it was because the cooperative farms had obtained capital for construction of superior irrigation facilities. Government credit and subsidies made available to cooperative farms for purchasing tractors and constructing tube wells were important incentives for establishing these farms. However, only three of the ten cooperative farms continued for more than a few years. Landowners decided that production and income from their land would be greater if they farmed it themselves or leased it to operators of small family-size farm units.

Results of studies made by Farm Management Research Centers in India indicate that gross output per acre averages higher on small farms than on large, privately operated farms, as shown below (Long, 31).

Farm-size groups	Gross output per acre in rupees
Smallest	219
Second smallest	188
Second largest	170
Largest	159

Krishna, in an Indian study using three measures of farm size--output per unit of input, output per unit of paid input, and output per hectare--concluded:

> Under present conditions the ratio of output to total input shows no consistent relation to the size of farm. In respect to the ratio of output to paid input the small farm turns out to be more productive than the large farm, and in respect to output per acre the small farms appear to be even more productive (32).

Data from the 1960 Census for Iran again indicate that crop yields average higher on small farms than on large farms, although yields do not decline continuously as farms become larger (table 30). However, much more labor is used per unit of cultivated area on small farms than on large farms. Small farms apparently achieve relatively high yields because of large labor inputs used to provide intensive irrigation facilities. The data indicate that factor proportions differ greatly among farms. They suggest that redistribution of labor on farms--so that land of the same quality is used equally--would increase total farm output.

A study by Bevan of yields, labor inputs, and income of different sizes of rubber holdings indicates very slightly larger yields per acre on small farms (5). But it is perhaps most significant that it shows larger incomes on the larger farms which accrue because of a more effective use of available labor. The number of trees topped per hour

Table 30.--Production per hectare of selected crops, and farm workers per hectare, by size of farm, Iran

Size of farm (hectares)	Wheat and barley		Cotton		Rice	Farm workers per hectare
	Not irrigated	Irrigated	Not irrigated	Irrigated		
	Kilograms					Number
Under .5.....	782	2,215	904	1,792	2,609	5.45
.5 to 1.....	607	1,720	847	1,360	2,108	2.14
1 to 2.....	553	1,399	855	1,014	2,309	1.22
2 to 3.....	442	1,259	791	1,113	2,274	.73
3 to 4.....	500	1,251	769	1,222	2,218	.50
4 to 5.....	517	1,202	799	902	2,092	.38
5 to 6.....	459	1,150	731	1,040	2,033	.24
5 to 10.....	438	1,123	944	1,291	1,965	.13
20 to 50.....	432	1,134	976	1,098	1,564	.07
50 to 100.....	452	926	1,026	694	1,453	.04
100 to 500.....	945	997	2,063	1,846	2,580	.01
500 and over.....	684	1,217	1,485	647	2,432	--
All sizes.....	489	1,176	957	1,132	2,157	.34

Source: 1960 Census, Iran.

increases from 56 on the small to 108 on the large farms. This would appear consistent with the assumption that considerable farm labor is underutilized in the less-developed countries.

Farm-size conditions in Japan are of special interest because of the large increases this country has achieved in agricultural productivity during the last 50 years. Numbers of farms in different size categories as measured by land area have not changed much since 1910. Most farms are as small as they have been for decades. In 1960, only about 2 percent of the farms were larger than 12.5 acres.

Crop yields in Japan are somewhat higher on the larger than smaller farms (table 31). But the multiple cropping ratio is larger for small farms, indicating that cropland is used more intensely on smaller units. Total receipts per unit of cultivated area are slightly smaller on farms with more than 2 cho (about 5 acres) than on smaller farms. This fact again shows that land on small farms is used more intensively. Small farms use much more labor per unit of cultivated area than do larger farms, but fertilizer inputs increase with size of farm.

Japanese experts show that while rice yields are not at present higher on the larger farms, the reverse was true during the 1930's (Ogura, 42). This apparently reflects the increasing influence on yields of fertilizers, pesticides, and other purchased inputs which are used in somewhat larger amounts on the larger farms. During the 1930's, the higher rice yield on small farms was associated with larger labor and manure inputs.

Data on distribution of number and land area of farm holdings by size are shown in tables 32 and 33 for the study countries arrayed by their 1948-63 rate of increase in crop output. Other factors than size distribution of holdings bear so heavily upon agricultural output that it is difficult to establish a definitive relationship between size distribution of holdings and agricultural output.

It is interesting to observe that Japan, with relatively small farms, has a record of long-sustained progress in increasing agricultural output, while Argentina has made very little agricultural progress during the last two decades within a framework of relatively large farms.

Table 31.--Crop yields, value of inputs, and total receipts per unit of cultivated area, Japan

Item	Size of farm (per cho)[1]					
	Less than .3	.3 to .5	.5 to 1.0	1.0 to 1.5	1.5 to 2.0	2.0 and over
Crop yields	Kilogram					
Paddy field rice	427	422	432	453	456	483
Upland rice	220	182	195	208	224	224
Barley	319	300	306	332	327	340
Wheat	256	254	263	273	272	268
Soybeans	121	126	125	128	128	132
Sweet potatoes	1,455	1,512	1,717	1,829	2,181	2,156
Potatoes	1,193	1,088	1,171	1,252	1,315	1,374
Inputs	1,000 yen					
Labor	27.0	25.2	24.0	20.3	11.6	13.4
Fertilizer	2.7	2.8	2.9	3.1	3.1	2.9
Total receipts	38.8	38.5	40.6	40.9	38.9	36.6
	Number					
Multiple cropping ratio[2]	1.52	1.49	1.47	1.44	1.39	1.27

[1] One cho is slightly more than one hectare.
[2] Ratio of cultivated area to planted area.

Source: Farm Household Survey, 1960, Japan.

Table 32.--Percentage distribution of total number of holdings, by size groups of holdings, 21 countries, selected years

Country	Year	Hectares												
		Under 0.5	0.5 and under 1	1 and under 2	2 and under 3	3 and under 4	4 and under 5	5 and under 10	10 and under 20	20 and under 50	50 and under 100	100 and under 200	200 and under 500	500 and above
		Percent												
Israel	1950	14			55			16	10	3	--	--	1	1
Mexico	1950	36			37			6	5	6	3	2	2	3
Costa Rica	1950	5			33			16	14	20	7	3	2	
Philippines	1948	19			65			10	4	2				
Tanganyika	1960	36											64	
Yugoslavia	1951	12			56			21	8	2	1			
Taiwan	1949	26	20	26	13	10		4	1					
Turkey	1952	18			44			22	10	4	2			
Venezuela	1950	54						30	8	3			3	2
Thailand	1950	15			55			21	9					
Brazil	1950	2			20			12	17	23	11	6	5	4
Greece	1929	37			49			10	3	1				
Iran	1960	17	10	14	11	8	6	18	12	4				
India	1954	39			45			10	4	2				
Poland	1960	10	23		12	18		26	10	1				
Argentina	1952				15			11	13	14	17	12	9	9
Japan	1960	34	30	26	5	2	1	1	1	1				
Spain	1962	17	11	14	10	7	5	15	10	7	2	1	1	
Colombia	1954	18			37			16	11	9	4	2	2	1
UAR	1950	53			39			5	2	1				
Jordan	1953				47			23	17	10	2	1		

Source: Number and Size of Holdings: World Agricultural Structure, Study No. 1, FAO, Rome, 1961.

Table 33.--Percentage distribution of total area of holdings, by size groups of holdings, 19 countries, selected years

Country	Year	Hectares												
		Under 0.5	Under 1	Under 2	Under 3	Under 4	Under 5	Under 10	Under 20	Under 50	Under 100	Under 200	Under 500	500 and above
		Percent												
Israel	1950	1				9		7	9	5	2	5	19	43
Mexico	1950					1		--	1	2	2	3	6	85
Costa Rica	1950					2		3	5	15	12	10	11	42
Philippines	1948	3				39		18	15	11	3	3	8	--
Tanganyika	1960						3						97	
Yugoslavia	1951	1				23		22	15	8	31			
Turkey	1952	2				17		20	19	17	25			
Venezuela	1950				1				3		3	2	7	84
Thailand	1950	--	--	--	--	--	--	--	--	--	--	--	--	--
Brazil	1950							1	2	7	7	8	13	62
Greece	1929	5				30		5	10	7	3	2	4	24
Iran	1960	1	11	3	4	4	5	21	27	20	5	6		3
India	1954	5				35		23	20	17				
Poland	1960	1	6			29		39	32		--	--	--	--
Argentina	1952								1	1	3	5	8	82
Japan	1960	9	21	34	12	5	3	7	6	3	--	--	--	--
Columbia	1954					3		4	5	9	9	12	17	41
UAR	1950	9				30		10	11	12	9	7	12	--
Jordan	1953					11		14	20	24	11	5	5	10

Source: Same as table 32. FAO, Rome, 1961.

CHAPTER 5.--TECHNOLOGY

Growth in man's capacity to produce foods and fibers (fig. 7) has been greatly augmented through improvements in agricultural technology and increases in capital and skills required to use them. Until the 19th century, most technological improvements were either accidental discoveries or products of relatively few individuals. Since the middle of the 19th century, however, a steadily growing stream of improved agricultural technologies has developed.

This modern stream of technologies has resulted neither from any upturn in native human intelligence nor from any mere natural acceleration in the growth of knowledge. Rather, it has resulted mainly from new policies, public and private, which have allocated resources and created new institutions expressly designed to increase knowledge of ways to expand agricultural output and productivity. In the United States, public institutions have included the U.S. Department of Agriculture, land-grant colleges, and agricultural experiment stations. The effectiveness of these agencies has been enhanced by agricultural extension and vocational agricultural education to disseminate knowledge of improved techniques and to develop the problem-solving abilities of farm people. The contributions of these agencies have been greatly supplemented, especially in recent decades, by the scientific and engineering research efforts of private universities, foundations, and business firms.

Modern technology has until very recently been largely concentrated in a few temperate zone countries, principally the United States, West European countries, and Japan. In these countries, it has made possible a level of farm technology that is much more productive than the traditional technologies of underdeveloped countries. It also provides greater scope for the economic use of much more capital and skills.

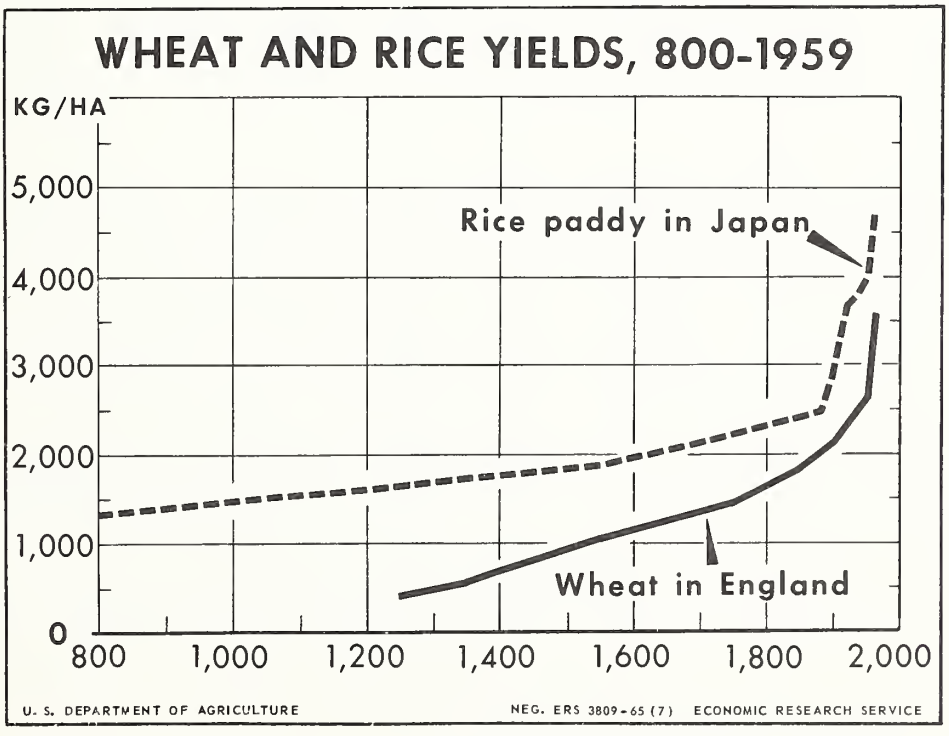


Figure 7

Differences in Current Technologies

Information available on the current level of agricultural technologies throughout the underdeveloped countries is limited and as yet highly general. Yield differences of major crops (table 34), although greatly influenced by soil and climatic conditions, provide broad indications of the level of applied technology. Fertilizer consumption, tractor numbers, use of insecticides, and use of improved crop varieties (tables 35-38) serve as more direct measures of selected technologies and help to explain levels and changes in crop yields.

Available data indicate that agricultural technologies of underdeveloped countries are still highly rudimentary. Those countries that have made the most rapid technological

Table 34.--Average annual yield per hectare of wheat, maize, rice, and cotton, in 24 study countries, the United States, and the Netherlands, 1949-53 and 1961-63

Country	Wheat		Maize		Rice		Cotton	
	1949-53	1961-63	1949-53	1961-63	1949-53	1961-63	1949-53	1961-63
Group I	100 kilograms							
Israel	6.9	[1] 10.0	9.7	40.4	--	--	--	9.5
Sudan	11.8	16.0	9.3	8.2	--	--	3.6	3.6
Mexico	8.8	16.8	7.5	[1] 9.4	18.0	22.5	3.3	5.7
Philippines	--	--	7.2	[1] 6.2	11.8	[1] 12.2	2.9	2.2
Tanganyika	5.8	NA	7.5	NA	12.3	NA	1.4	1.8
Yugoslavia	12.0	[1] 16.7	13.4	[1] 21.1	25.8	38.7	.9	2.1
Taiwan	9.6	19.7	14.1	17.5	22.1	[1] 32.1	3.4	2.1
Turkey	10.0	[1] 10.3	12.4	14.0	35.1	38.7	2.5	3.2
Venezuela	4.7	5.3	11.4	[1] 11.0	11.4	[1] 15.3	2.8	2.2
Thailand	--	--	9.1	20.0	13.1	[1] 14.3	2.0	2.5
Brazil	7.4	6.9	12.4	[1] 13.0	15.7	[1] 17.1	1.5	1.8
Greece	10.2	[1] 15.3	9.3	14.1	31.3	39.3	3.0	4.2
Group II								
Iran	9.0	8.6	10.3	NA	19.3	19.6	2.0	2.8
India	6.7	8.4	6.9	9.5	11.3	[1] 14.8	.9	1.2
Poland	12.5	18.7	NA	25.4	--	--	--	--
Argentina	11.5	12.6	14.8	17.7	30.5	33.6	2.4	2.3
Chile	11.9	[1] 13.7	13.8	20.7	29.0	26.9	--	--
Japan	18.5	26.1	14.2	25.9	40.0	[1] 50.5	1.2	--
Spain	8.7	[1] 9.5	15.6	23.0	48.6	62.5	1.6	3.1
Colombia	7.2	9.1	10.7	11.2	20.4	19.5	2.2	4.5
UAR	18.4	[1] 25.1	20.9	[1] 24.0	37.9	52.3	5.2	5.6
Pakistan	8.7	[1] 8.1	9.8	10.0	13.8	[1] 15.9	2.0	2.4
Tunisia	4.9	3.4	3.1	NA	--	--	--	--
Jordan	7.0	5.2	--	--	--	--	--	--
United States	11.2	16.9	24.9	37.8	25.6	39.5	3.2	5.0
Netherlands	36.5	43.8	32.5	38.4	--	--	--	--

[1] A major crop grown; area consisting of at least 10 percent of total area in field crops.

Source: Production Yearbook, 1963, Vol. 17, FAO, Rome.

Table 35.--Consumption of commercial fertilizer nutrients per hectare of arable land, 26 study countries, United States, and Netherlands, 1948-49 - 1952-53 and 1962-63[1]

Country	Fertilizer nutrients consumed per hectare of arable land								Change in total fertilizer nutrients per hectare of arable land
	1948-49 - 1952-53				1962-63				
	Nitrogen	Phosphate	Potash	Total	Nitrogen	Phosphate	Potash	Total	
	Kilograms								
Group I									
Israel	1.5	1.9	0.3	3.7	49.5	29.7	6.0	85.2	81.5
Sudan	0.7	--	--	0.7	2.6	0.1	0.2	2.9	2.2
Mexico	0.6	0.5	0.1	1.2	7.6	1.9	0.6	10.1	8.9
Costa Rica	6.2	15.8	--	22.0	31.4	39.8	15.0	86.2	64.2
Philippines	4.0	2.5	0.2	6.7	4.3	2.2	2.9	9.4	2.7
Tanganyika	NA	NA	NA	NA	0.1	0.1	0.1	0.3	NA
Yugoslavia	0.8	1.2	0.4	2.4	16.1	13.4	9.4	38.9	36.5
Taiwan	62.3	17.8	8.0	88.1	127.8	34.8	27.4	190.0	101.9
Turkey	0.3	0.2	0.1	0.6	1.3	1.3	0.1	2.7	2.1
Venezuela	0.5	0.2	0.3	1.0	1.1	2.0	1.5	4.6	3.6
Thailand	0.3	0.1	--	0.4	1.2	0.6	0.3	2.1	1.7
Brazil	0.6	1.5	0.6	2.7	3.9	3.9	3.6	11.4	8.7
Greece	6.7	5.5	1.5	13.7	25.1	21.6	33.6	80.3	66.6
Group II									
Iran	NA	NA	NA	NA	0.5	0.2	0.1	0.8	NA
India	0.5	0.1	0.0	0.6	2.6	0.6	0.2	3.4	2.8
Poland	5.6	6.1	10.4	22.1	18.6	14.6	22.3	55.5	33.4
Argentina	0.2	0.2	0.1	0.5	0.3	0.1	0.1	0.5	0.0
Chile	2.5	5.5	0.9	8.9	6.0	9.4	1.9	17.3	8.4
Japan	72.2	44.1	28.5	144.8	110.2	76.6	83.3	270.1	125.3
Spain	3.9	7.8	2.0	13.7	16.7	15.0	4.6	36.3	22.6
Colombia	1.0	2.2	1.9	5.1	4.8	1.0	5.5	11.3	6.2
Nigeria	NA	NA	NA	NA	(2)	(2)	(2)	0.1	NA
UAR	40.1	6.8	0.2	47.1	87.2	21.0	1.6	109.8	62.7
Pakistan	0.2	0.0	--	0.2	4.1	1.1	0.5	5.7	5.5
Tunisia	0.3	2.2	0.2	2.7	0.4	1.9	0.4	2.7	0.0
Jordan	0.5	0.1	--	0.6	0.5	1.3	0.3	2.1	1.5
United States	6.1	10.1	6.4	22.6	11.2	14.7	11.7	37.6	15.0
Netherlands	44.1	34.9	45.6	124.6	293.4	101.3	123.8	518.5	393.9

[1] Fertilizer nutrients in terms of N, P_2O_5, and K_2O.
[2] Less than 0.05 kilograms.

Sources: Fertilizers: An Annual Review of World Production, Consumption and Trade, 1963, and Production Yearbook, 1963, FAO, Rome.

progress are generally those that have achieved the most rapid increases in crop yields. As indicated in table 34, individual crop yields vary considerably among countries, with the higher level of yields generally having been achieved in countries where fertilizer applications are highest, where mechanization is most advanced, where insecticides and pesticides are most commonly used, and where most progress has been achieved in the development and use of improved crop varieties.

Agricultural techniques are most advanced in Japan, Israel, Argentina, Greece, Yugoslavia, Poland, Spain, and Chile. Japan's superior position has been achieved through technological transfers and through its own research and educational programs. Transfers of technology from the United States and West European countries account for much of the technological superiority in the rest of these countries. The recentness and rapidity of the technological transformation in Israel are especially interesting. It has occurred under uniquely favorable conditions with respect to capital, skills, motivations, and institutions. Nevertheless, Israel's experiences suggest that technological transfer potentials of long-run applicability to other countries, especially to those in the Middle East, may be fairly large.

Table 36.--Tractors used in agriculture per 1,000 hectares, 24 study countries, 1949-50 and 1961-62

Country	Tractors per 1,000 hectares of arable land		
	1949-50	1961-62	
		All tractors	Garden tractors
Group I	----------	Number	----------
Israel	--	19.24	.95
Sudan	.02	--	--
Mexico	--	1.96	--
Costa Rica	--	1.95	--
Philippines	.19	.60	--
Tanganyika	.23	.16	--
Yugoslavia	.86	4.55	--
Taiwan	--	.56	--
Turkey	.16	1.68	--
Venezuela	--	4.11	--
Greece	.78	6.11	2.16
Group II			
Iran	--	.36	--
India	.05	.21	--
Poland	.90	4.45	--
Argentina	--	3.69	--
Chile	--	[1] 2.72	--
Japan	--	[1] 1.55	232.82
Spain	.72	3.07	.13
Colombia	--	4.66	--
Nigeria	--	.02	--
UAR	--	4.28	--
Pakistan	--	.15	--
Tunisia	1.37	--	--
Jordan	.09	.97	--

[1] Number as reported for 1960.

Source: Production Yearbook, 1963, FAO, Rome.

Among the study countries, agricultural technologies are least advanced in the tropical and semitropical countries. Taiwan, which lies astride the Tropic of Cancer, is an exception, and therefore merits special study. In many underdeveloped countries, sizeable commercial sectors produce such crops as cotton, rubber, tea, sugar cane, cocoa, and bananas, mainly for export markets. Although quantitative information on levels of applied technology in these sectors is not readily available, it is generally well-known that in their uses of modern technological inputs, these sectors stand in sharp contrast to the rest of the agriculture in their respective countries.

Table 37.--Use of specified pesticides, fungicides, and herbicides in agriculture, 12 study countries and the United States, 1960

Area and country[1]	DDT	Phosphorus compounds	Arsenicals	Spray oils and dinitro compounds	Sulphur and compounds	Copper and compounds	Mercury compounds	Herbicides
	Metric tons[2]							
Latin America								
Argentina	394	131	436	--	567	1,294	3	1,506
Europe								
Greece	177	84	161	396	13,027	8,039	31	276
Poland	44,827	12,783	--	590	1,206	640	663	1,030
Spain	17,259	634	1,530	6,148	22,541	8,567	410	407
Near East & So. Asia								
UAR	469	77	18	143	1,799	88	--	--
India	1,104	499	12	6	328	8,830	303	68
Israel	175	360	30	812	2,060	130	30	14,194
Pakistan	508	1,007	--	--	36	452	100	134
Far East								
Japan	10,622	36,958	3,517	7,695	15,872	9,171	55,503	8,012
Philippines	[3] 231	[4] 39	--	--	--	88	--	[3] 23
Taiwan	[3] 39	[3] 835	--	--	38	--	[3] 3	--
Thailand	[3] 138	[3] 19	3	[5] 13	--	--	[3] 3	--
United States	31,818	18,247	8,386	--	--	15,095	129	34,621

[1] Data not available for Brazil, Chile, Colombia, Costa Rica, Mexico, Venezuela, Nigeria, Sudan, Tanganyika, Tunisia, Yugoslavia Iran, Jordan, Turkey, and the Philippines. [2] Each category shown is given the total quantity of material used without regard to the concentration of active ingredients. [3] 1959. [4] 1958. [5] 1958-59 average.

Source: Production Yearbook, 1962, FAO, Rome.

Table 38.--Relationship between seed status, proportion of crop area in improved varieties, and crop yield changes for rice, wheat, and maize, selected countries, 1948-62

Commodity and country	Seed status[1]	Proportion of crop area in improved varieties	Yields per hectare		
			1948-52	1960-62	Change
Rice	Rating	Percent	---100 Kg/Ha----		Percent
Japan	1	100	40.0	50.5	26
Taiwan	1	95	19.1	25.4	33
Venezuela	2	90	11.4	15.1	33
Chile	3	65	29.0	27.0	-7
UAR	3	35	37.9	52.8	39
Pakistan	4	5	13.8	15.9	15
Iran	4	3	19.3	19.6	2
Wheat					
Japan	1	100	18.5	26.1	41
Netherlands	1	100	36.5	43.8	20
Mexico	1	85	8.8	16.7	90
Chile	2	80	11.9	13.7	15
Pakistan	2	7	8.7	8.1	-7
UAR	3	30	18.4	25.1	36
Colombia	3	20	7.2	9.1	26
Iran	3	10	9.0	[2] 7.8	-13
Jordan	4	15	7.0	5.4	-23
Maize					
Venezuela	2	20	11.4	11.0	-4
Pakistan	2	8	9.8	10.0	2
Chile	3	50	13.8	20.7	50
Colombia	3	20	10.7	11.2	5
UAR	3	7	20.9	24.1	15

[1] Index of present efficiency in the chief factors influencing development production, distribution, and use of better seeds, using rating of 1 to 4 with quality highest for rating of 1.
[2] 1960-61.

Source: Statistics Division, FAO, Rome, and special FAO "Seed Status" inquiry.

Present Technological Basis For Increasing Output

Appraisals of existing technological bases for increasing agricultural output in underdeveloped countries differ widely. Much of this difference relates to the transferability of technological improvements of economically advanced nations. To the extent that they are readily transferable to underdeveloped countries, such improvements represent new, virtually free resources for increasing their agricultural output and productivity. Hence, transfers merit careful investigation and more experimentation than has yet been undertaken.

Local Techniques Now in Use on Best Farms

Widespread adoption of the more productive techniques already in use on the best farms in underdeveloped countries is one important type of technological transfer. A large part of the increases in agricultural output in Japan in the two or three decades immediately following the Meji Restoration has been credited to this approach (Ogura, 42). This method of increasing efficiency has also been used extensively in Western Europe and the United States.

There has been little systematic research into the indigenous technological potentials that underdeveloped countries now have. In most underdeveloped countries, yields of major crops grown on the same type of soil differ markedly from village to village and even from farm to farm within the same village, year after year (Mosher, 38). These observed differences suggest that now underutilized technological bases may be used to increase agricultural output. Better technologies of an indigenous nature may not lead to vast increases in output, but they may often facilitate further progress.

Technological Exchange Between Countries

Numerous technological transfers have been successfully made from more developed into underdeveloped countries, especially into commercial sectors growing major export crops. Generally, however, such transfers appear to be much more difficult to make in agriculture than in nonagricultural enterprises. One likely reason is that nonfarm technological transfers are commonly made into whole, newly structured producing units. Hence, it is easier to achieve good complements of the other factors and conditions which interact with the improved nonfarm technologies to influence their productivity. In contrast, attempts are frequently made to inject imported farm technologies into already established farm plants, without close attention to conditions that have made the improved technology work in the locality of its origin. Sometimes overlooked is the fact that when the new technology is set in a different physical environment, it may contribute little to output.

Success in international transfer of technology also requires attention to economic and social as well as to physical relations. For one thing, much improved technology has been produced to maximize profits under particular land, labor, and capital supply ratios, or under particular product-demand conditions and their associated price relationships.

Secondly, the successful introduction of many new techniques requires concerted action by many producers and sometimes community-wide, or even nationwide cooperation. Economies of scale in procuring production requisites and marketing products preclude use of some technologies, unless they are adopted somewhat simultaneously by a relatively large number of producers. Eradicating crop and animal pests and reducing soil salinity are areas where a concerted and well-coordinated action over a large area is usually required.

Finally, religious beliefs and practices, social class structures, and social, political, and economic patterns often influence the ease of adoption of more advanced technologies, whether imported or domestically developed.

The successful transfer of farm technologies between countries often requires that extension and research efforts be closely coordinated. Extension personnel need to have a keen appreciation of the functions of research and to be able to apply research findings to the solution of farmers' problems. In turn, researchers must maintain a close association with extension personnel in order to best direct their efforts toward solution of problems that agriculturalists face. Close cooperation between physical and social science specialists is also essential.

Available information on interrelationships between technologies and other factors comprising the physical, economic, and social environment is now too limited to assess definitively the potential of technological transfers. The experience basis now available, however, indicates some transportable techniques that are fairly easy to adopt and that yield good results with a minimum of change in other practices. One of the most important of these involves the use of commercial fertilizers.

Fertilizers

Thousands of fertilizer experiments and demonstrations have been conducted during recent years on major crops in the world's less-developed countries. These reveal highly favorable results from using commercial fertilizers on major crops. For example, in summarizing results from several thousand trials in cultivators' fields throughout India, H. L. Richardson reported increases of paddy rice from 30 pounds of N (Nitrogen) and 30 pounds of P_2O_5 averaging 590 pounds per acre--an increase equal to 52 percent of India's rice yield in 1959 (47).

Increases in yields of milled rice from 30 kilograms of nitrogen averaged 315 kilograms in East Pakistan, 269 kilograms in Thailand, and 228 kilograms in Iran. High rice yield responses were also reported for phosphate fertilizers, with 30 kilograms of P_2O_5 yielding an increase of 214 kilograms of milled rice in East Pakistan, 246 in Iran, and 265 in Thailand.

The results from applications of fertilizers to maize, wheat, and rice in several countries are summarized in table 39. On the basis of these results, expansion in fertilizer consumption can add materially to increasing agricultural output.

Generally, there is a close relationship between uses of fertilizers and crop yields (fig. 8). Other factors than fertilizers help to account for the fertilizer-yield associations observed, but there is no country in the world where high crop yields can be maintained long without continuing large inputs of commercial fertilizers. These requirements have been increased with every improvement in varieties, pest controls, and other factors increasing crop yields, and thereby the amount of crop materials annually taken from the soil. Thus, fertilizers bear such a highly complementary relationship to other yield-increasing practices that the amounts of fertilizers used per hectare of land can be used as a fairly good index of progress in adoption of yield-increasing technologies generally.

Expanding use of fertilizers is particularly important in the early stages of transition from traditional to modern agricultural production methods. Williams and Couston state that

> .....the response from fertilizer is usually strikingly visible--the difference in growth, color of the plant, and size of the crop or fruit are evident to the eye of even the untrained observer. Secondly, fertilizer is something tangible. The farmer can see it, handle it, and know when he has applied it. Another advantage is that the farmer gets relatively quick returns from the use of fertilizer, especially on annual crops. He can put the fertilizer on his crops and, in a few short months, harvest and measure the increased production. Yet the capital required is much less than for many other improvements that may be desirable. While adequate credit for farmers to purchase plant food is a problem in most areas of the world, such credit is required for only a short

Table 39.--Results of fertilizer trials and demonstrations on maize, wheat, and rice in selected countries

Commodity	Country[1]		Kilograms of fertilizer applied per hectare (N, P_2O_5, K_2O)	Yield per hectare		Increase in yield per hectare		Net return on fertilizer used		Output per kg. of nutrients
				Control plot areas	Fertilized areas	Amount	Percentage	Per hectare	Per dollar value of fertilizer	
			Kg.	Kg.	Kg.	Kg.	Pct.	Dol.	Dol.	Kg.
Maize.....	El Salvador		45-45-45	2305	3155	850	37	56	3.8	9.4
	Ghana	-Forest	22-0-0	1168	1465	297	25	11	2.2	13.5
		-Savannah	22-22-22	1189	1713	524	44	13	1.6	7.9
	Honduras	-(Hybrid)	90-90-90	3892	7215	3323	85	176	4.1	12.3
		-(Local)	45-45-45	2446	3192	746	30	24	1.8	5.5
	Morocco	-Casablance-Rabat	40-60-0	731	1162	431	59	1	1.0	4.3
		-Marrakech-Safi	20-40-0	723	1139	416	58	6	1.5	6.9
		-Tetouan	20-40-0	1397	1805	408	29	6	1.6	6.8
	Nigeria	-Forest	22-22-34	236	350	114	48	-17	.3	1.5
		-Savannah	28-17-39	637	858	221	35	-13	.6	2.6
	Turkey	-Black Sea	100-60-0	1421	2338	917	65	29	1.6	5.7
		-Marmara-Aegean	100-60-0	1870	2760	890	48	27	1.6	5.6
Wheat.....	Lebanon	-Akkar	40-35-20	21120	1900	780	70	44	2.8	8.2
	Morocco	-Casablanca-Rabat	20-37-47	1481	1867	386	26	9	1.4	3.7
		-Fes Meknes-Taza	20-37-47	1437	1682	245	17	-2	.8	2.4
		-Tetouan	20-37-47	472	934	462	98	14	1.7	4.4
	Syria	-(Irrigated)	60-60-60	1914	2780	866	45	4	1.1	4.8
		-(Nonirrigated)	0-40-0	725	977	252	35	4	1.3	6.3
	Turkey	-Central Anatolis	0-60-0	920	1350	430	47	21	2.3	7.2
		-Threca	60-60-60	1260	2270	1010	80	57	2.7	5.6
Rice..... (paddy)	El Salvador		45-45-45	2239	3291	1052	47	91	4.6	7.7
	Ghana	-Forest	22-22-22	1198	2101	903	75	64	3.7	13.4
		-Savannah	45-45-45	1287	3134	1847	144	131	3.8	13.7
	Nigeria	-Forest	22-22-22	1829	2335	506	28	22	1.7	7.6
		-Savannah	22-34-67	1417	1706	289	20	1	1.0	2.3
	Senegal	-Casamance	0-0-45	1266	1763	497	39	33	12.0	11.0
	-	-Fleuve	0-0-45	2760	3156	396	14	28	10.0	8.8
		-Sine Saloum	45-0-0	901	1326	425	47	25	3.5	9.4

[1] Data by area, variety, and irrigated or nonirrigated included where available.

Source: Review of Trial and Demonstration Results, 1961-62, FFHC Fertilizer Program, FAO, Jan. 1964.

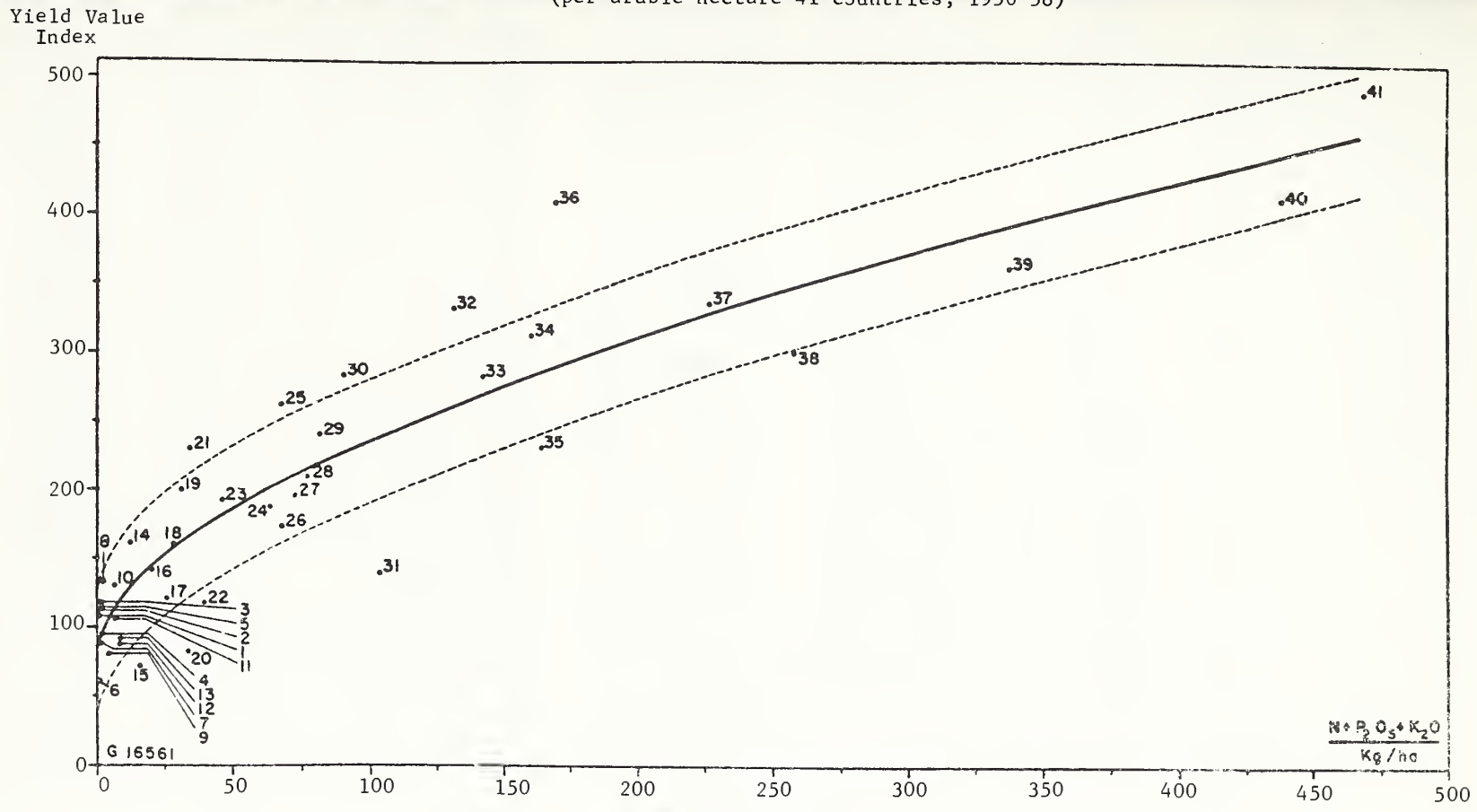
NOTE: Results shown include only that fertilizer application showing the largest additional return per hectare of the crop. In some instances, a different fertilizer application produced a larger increase in yield, a higher net return per dollar invested in fertilizer, or a larger output per kilogram of fertilizer applied.

time and has a rapid turnover. Hence, teaching farmers how to use fertilizer advantageously can be a strong motivational factor in encouraging many other changes that are necessary to achieve efficient agricultural production (69).

In the 24 study countries for which data were available, fertilizer consumption increased from 1.7 million metric tons of nutrients in 1949-50 to 5.4 million metric tons in 1962-63. Fertilizer consumption per hectare of arable land, however, is still very low in most countries. In 1962-63, for example, consumption of fertilizer nutrients per hectare of arable land was less than 1 kilogram in Tanganyika, Nigeria, and Argentina, and below 4 kilograms in Turkey, Jordan, Thailand, India, Sudan, and Tunisia (table 35). Although fertilizer consumption in these 9 countries has increased several fold in the 11-year period considered, the increase in yields due to fertilizers is certain to have been small. For example, assuming a physical response of 10 kilograms of food grains per kilogram of fertilizers applied, total yield increase due to fertilizer would be less than 30 kilograms per hectare in each of the above countries.

Based on the assumption of this 10 to 1 response ratio, the additional fertilizer consumed in India, Thailand, and Pakistan would account for only about 20 percent of the increases in grain yields. In Turkey, Mexico, Venezuela, Yugoslavia, and Greece, between one-fifth and one-half of the increase in grain yields would be explained by increases in fertilizer use. Increased fertilizer use would account for two-thirds or more of the increases in Chile, Egypt, Brazil, Taiwan, Israel, Spain, and Japan.

(per arable hectare 41 countries, 1956-58)



FERTILIZER USE

1. Burma	8. Indonesia	15. South Africa	22. Australia	29. France	36. Switzerland
2. Argentina	9. Philippines	16. Yugoslavia	23. Italy	30. Austria	37. West Germany
3. Thailand	10. Canada	17. Spain	24. Peru	31 South Korea	38. Japan
4. Pakistan	11. Colombia	18. Greece	25. Egypt	32. Denmark	39. Belgium Luxembourg
5. Turkey	12. Mexico	19. U.S.A.	26. Finland	33. United Kingdom	40. Netherlands
6. India	13. Brazil	20. Portugal	27. Israel	34. Norway	41. New Zealand
7. Syria	14. Chile	21. Ceylon	28. Sweden	35. Taiwan	

Source: Williams and Couston (69).

Figure 8

The accuracy of these estimates depends on the validity of the assumed 10:1 response ratio and on the further assumption that fertilizer applications on grain crops increased at the same rate as on all crops. Although in some countries much of the increased fertilizers consumed may have been applied to vegetable and other specialty crops, there is little question that increased use of fertilizers has largely accounted for increased crop yields in recent years. In Japan and Taiwan, where fertilizer consumption per hectare is now quite high, average physical response is probably below a 10 to 1 ratio.

As consumption of fertilizer has increased, other technical improvements apparently have been made on such a scale that fertilizer consumption can be used as a good index of the level of technology. Williams and Couston, for example, report an 0.87 coefficient of correlation between fertilizer consumption and grain yields in 40 countries (69).

Fertilizer supplies and cost-price relationships.--In many countries, lack of improved seeds, fertilizers, pesticides, and many other factors when needed has seriously impeded adoption of improved farming techniques. Farmers in all study countries where the AID now has an operating mission were questioned on the availability of such production requisites. In most of the countries, lack of availability appeared to be a serious deterrent to their increased use (table 7, Chapter 1).

Where production requisites are available, however, their high supply prices relative to farm product prices further discourage their use in some of the study countries. This is especially true for fertilizer, the one factor on which price data are available for several of the study countries (table 40). Using fertilizer and farm product prices and price relationships shown in tables 40 and 41, for example, in India it would be necessary to obtain an increase in yield of rice paddy of 5.23 kilograms to pay for 1 kilogram of fertilizer; but in Japan a yield increase of only 1.35 kilograms would be needed to pay for 1 kilogram of fertilizer (table 42).

Subsidies have been used in some of the study countries in order to introduce and expand the use of various fertilizers. The low prices paid for fertilizers by the farmers of Pakistan, for example, result mainly from high government subsidies. In Taiwan, while current fertilizer prices are high, free distribution of at least limited amounts of fertilizers in the past helped to stimulate the early adoption of fertilizers. In Japan, the relationship of high commodity prices and low prices for fertilizers, both having been influenced by government price and trade policies and by level of general economic development, has helped make high levels of fertilizer use profitable.

Because of the large uncertainty attending the use of fertilizers or other improved techniques when they are first introduced, subsidies can stimulate initiation of their use. Unless high profits have been demonstrated, farmers living near subsistence levels are often slow to adopt new technologies because of risk and uncertainty elements.

The potentials for increasing output through the use of fertilizers will grow as improvements are made in the complement of other practices and conditions which influence yields and profits. For example, new high-yielding, short- and stiff-strawed wheat and rice varieties adaptable to a wide range of environmental conditions are capable of utilizing 80 pounds or more of nitrogen fertilizer per acre, whereas traditional varieties can utilize very little additional nitrogen because of lodging.

The economic feasibility of fertilizer use will also be increased as sources of supply are improved, as economies are achieved in procurement and distribution of fertilizers, and, overall, as agriculture becomes more commercial. From the standpoint of fertilizer supplies, construction of large new fertilizer plants in many less-developed countries is encouraging (table 43).

Major industrial firms with broad bases of experience are becoming active not only in production but in promotion, sales, and distribution. With improvements in transport facilities, removal of internal trade barriers, and improvements in production technologies, the cost of putting fertilizer nutrients into agricultural uses in less-developed countries can be substantially reduced.

Table 40.--Fertilizer prices paid by farmers in selected countries, 1962-63[1]

Country	Fertilizer used per hectare	Price of fertilizer per kilogram			
		N	P_2O_5	K_2O	Average[2]
	Kg.	U.S. cents			
Latin America					
Chile	17.3	27.9	12.2	11.6	17.6
Costa Rica	86.2	34.4	15.9	13.9	22.3
Europe					
Greece	80.3	20.9	15.8	11.8	15.7
Spain	36.3	26.8	20.0	6.5	21.4
Near East and So. Asia					
UAR	109.8	38.9	21.9	17.0	35.3
India[3]	3.4	36.8	31.9	13.0	34.5
Israel	85.2	22.3	15.9	6.6	19.0
Pakistan	5.7	14.0	11.0	4.9	12.6
Far East					
Japan	270.1	27.8	23.6	9.7	21.0
Philippines[4]	9.4	32.2	25.6	12.0	24.4
Taiwan	190.0	44.0	23.6	12.5	35.7
Thailand	2.1	24.0	25.0	13.5	22.8
United States	37.6	26.7	19.7	9.8	18.7

[1] Prices are for major materials used net of subsidy except where noted.
[2] N, P_2O_5, and K_2O in ratios used per hectare of arable land as shown in table 35.
[3] Subsidies at rate of 25 percent are given in some parts of country.
[4] Market price without deduction of subsidies.

Largely as a result of improvements in fertilizer production technologies, the cost f fertilizers has increased very little in most of the study countries since the middle 950's. A major technological change in production has been the development of larger, ore efficient plants, particularly for manufacture of ammonia of higher analysis rtilizer materials. The latter have helped to reduce transport and handling costs, which re substantial cost items in most of the less-developed countries.

nproved Crop Varieties

It is estimated that application of genetic principles to plant breeding and distribution improved seed and plant materials to farmers have recently accounted for one-fourth one-third of the increases in crop production in West European countries (Fischnich,). Improved crop varieties have contributed to remarkably high yield increases of ajor crops in Japan, Taiwan, and Mexico as well. Further indication of the effects of ariety improvements on yields is shown in tables 38 and 44.

Rice yields in Japan, with a seed status rating of excellent or 1, for example, in-eased from 4,000 kilograms per hectare during 1948-52 to 5,000 in 1960-62. Yields in an, with a rating of poor or 4, increased only 2 percent. The relationships between seed atus and yield increases, however, are not highly consistent, reflecting differences tween countries in other factors influencing yield increases and differences in inter-etation of the survey questions on which these ratings are based.

Table 41.--Prices of wheat and rice (paddy), and ratio of fertilizer prices to commodity prices, selected countries, 1960-61[1]

Commodity and country	Commodity price per kilogram	Ratio of fertilizer prices to commodity prices			
		N	P_2O_5	K_2O	Average[2]
Wheat	U.S. cents				
UAR	5.8	6.71	3.77	2.93	6.09
India	9.4	3.91	3.39	1.38	3.67
Japan	11.6	2.40	2.03	0.84	1.81
Pakistan	8.4	1.67	1.31	0.58	1.50
Spain	9.3	2.88	2.15	0.70	2.30
United States	8.3	3.22	2.37	1.18	2.25
Rice (paddy)[3]					
UAR	4.6	8.46	4.76	3.70	7.67
India	6.6	5.58	4.83	1.97	5.23
Japan	15.6	1.78	1.51	0.62	1.35
Pakistan	11.0	1.27	1.00	0.45	1.15
Philippines	7.8	4.13	3.28	1.54	3.13
Thailand	5.5	4.36	4.55	2.45	4.14
United States	10.9	2.45	1.81	0.90	1.72

[1] Represents kilograms of increased production required to equal cost of a kilogram of fertilizer.

[2] N, P_2O_5, K_2O in ratios used per hectare of arable land as shown in table 35.

[3] Milled rice prices converted to paddy, using coefficient of 0.66.

Source: FAO Production Yearbook, 1963.

The present status of country programs designed to improve seed quality is shown for wheat, rice, and cotton in table 45. Most of the study countries for which information is available rank relatively low in their efforts thus far to improve the seed quality. Mexico, Poland, and Yugoslavia are notable exceptions. It is also known that both Japan and Taiwan have developed good seed research, control, and distribution programs.

More important than the variety improvements already made in the agriculture of individual countries is the progress made in a few major research centers in developing basic genetic inputs for major crops, and for cereals in particular. High sensitivity of cereal varieties to sunlight has been a major hindrance to successful transfer of improved varieties from one region to another. A well-known example of such difficulty was experienced in the 1940's when corn hybrids were transferred from the North Central States into the southern United States. Within recent years, however, geneticists have developed improved varieties of wheat so insensitive to changes in length of day that they can be successfully transferred into any part of the world lying between the latitudes of 0 and 50 degrees, as long as there are adequate moisture and soil fertility.

Table 42.--Increases in yield of wheat and rice needed to cover cost of 50 additional kilograms of fertilizers, at 1962-63 prices, selected countries

Commodity and country	Yields per hectare, 1961-63[1]	Fertilizer nutrients used per hectare of arable land[2]	Increase above 1961-63 yields required to pay for 50 additional kilograms of fertilizer nutrients[2]		Fertilizer to yield response ratio required to cover fertilizer costs
			Amount	Percent	
Wheat	100 kg.	Kg.	100 kg.		
UAR	25.1	109.8	3.0	12.0	6.09
India	8.4	3.4	1.8	21.4	3.67
Japan	26.1	270.1	0.9	3.4	1.81
Pakistan	8.1	5.7	0.8	9.9	1.50
Spain	9.5	36.3	1.2	12.6	2.30
United States	16.9	37.6	1.1	6.5	2.25
Rice (paddy)					
UAR	52.3	109.8	3.8	7.3	7.67
India	14.8	3.4	2.6	17.6	5.23
Japan	50.5	270.1	0.7	1.4	1.35
Pakistan	15.9	5.7	0.6	3.8	1.15
Philippines	12.2	9.4	1.6	13.1	3.13
Taiwan	32.1	190.0	2.0	6.2	3.97
Thailand	14.3	2.1	2.1	14.7	4.14
United States	39.5	37.6	0.9	2.3	1.72

[1] As shown in table 34.
[2] N, P_2O_5, and K_2O in ratios shown in table 35.

In regard to cereals generally, Dr. Albert H. Moseman, Director for the Agricultural Sciences, The Rockefeller Foundation, states:

> Improved crop varieties of most of the principal food grains can be made available for almost any part of the world within a period of six years' time if proper attention is given to the necessary adaptive research.[5]

Dr. Moseman states that the short-strawed variety of wheat, Norin 10, which was introduced from Japan after World War II, has been used in breeding the Gaines variety. The Gaines variety, which produced approximately 190 bushels per acre in the Pacific Northwest in 1964,

> .....is a parent of the several semi-dwarf varieties developed in the Rockefeller Foundation's cooperating program in Mexico. These wheats have yielded up to 120 bushels per acre in the Yaqui Valley of Mexico and now occupy more than 85 percent of Mexico's wheat acreage. The Mexican wheats have proved to be exceptionally productive also in India. They are not photosensitive and so will mature a certain number of days after they are planted, regardless of the length

[5] Moseman, Albert H., "Food, People and Private Enterprise." A paper presented at the American Seed Trade Association, 9th Hybrid Corn Industry-Research Conference, Chicago, Ill. December 9-10, 1964.

Table 43.--Capacity of new fertilizer projects under construction or in planning stage, 18 study countries

Country	Nitrogenous fertilizers	Phosphate fertilizers
	Metric tons	
Latin America		
Argentina	189,000	--
Brazil	83,500	16,500
Mexico	40,000	17,000
Africa		
Sudan	40,000	--
Tunisia	52,000	100,000
Europe		
Greece	164,000	100,000
Poland	896,000	160,000
Spain	415,300	45,000
Yugoslavia	67,000	--
Near East & So. Asia		
UAR	43,000	19,000
India	1,201,000	346,500
Israel	--	50,000
Pakistan	231,000	--
Turkey	66,000	--
Far East		
Japan	1,140,100	9,000
Philippines	82,000	69,000
Taiwan	110,000	10,000

Source: World Fertilizer Atlas, 1964, The British Sulphur Corporation, Ltd., 40 Great Titchfield Street, London W. 1.

of day. The early maturity of these varieties and the rather definite time span from planting to harvest permits the production of two, or possibly three, crops during a twelve-month period. This trait also permits the acceleration of breeding programs to incorporate disease resistance, grain quality, and other characteristics that may be required in the successful adaptation of the higher yielding wheats to different environments.

Some varieties of rice that have been tested at the International Rice Research Institute at Los Banos, in the Philippines, also have been found to be nonphotosensitive and adapted to a wide range of environments in the tropics. These short- and stiff-strawed wheat and rice varieties are capable of utilizing 80 pounds or more of nitrogen fertilizer per acre and should permit the production of yields that are anywhere from double to fourfold the production of local varieties in many parts of the world.[6]

Mechanical Improvements

Improvements in farm machines and implements have contributed to increasing agricultural output and productivity in the now economically advanced nations. Many modern implements, however, represent relatively large capital investments, and are used

[6] See footnote 5.

Table 44.--Yield changes of selected crops resulting from use of new and improved varieties, selected countries, 1948-62

Country	Crop	Seed status[1]	Proportion of crop area in new or improved varieties	Yields per hectare		
				1948-52	1960-62	Change
		Rating	Percent	100 kg.	100 kg.	Percent
			Mainly new varieties			
Taiwan.....	Pineapple[2]	1	100	97.3	174.7	80
	Sugarcane[3]	1	100	64.4	[4] 97.5	51
Israel.....	Sorghum[5]	1	95	6.6	21.1	220
Venezuela.....	Sugarcane	2	95	100.0	486.0	386
			Mainly unimproved varieties			
Colombia.....	Maize	3	20	10.7	11.2	5
Pakistan.....	Jute	4	5	14.2	15.0	6
	Chick peas	3	25	6.1	5.4	-12
Venezuela.....	Coffee	2	10	1.5	1.7	13
	Maize	2	20	11.4	11.0	-4

[1] An index measuring existing efficiency in the chief factors influencing production, distribution, and use of better seeds, using rating of 1 to 4 with quality highest for rating of 1.

[2] 64 percent of pineapple area was in Smooth Cayenne in 1950, compared with 100 percent in 1959.

[3] Introduction of N:Co 310 strain was made in 1951-52; 91 percent of the crop was in this variety by 1956-57.

[4] White sugar.

[5] Native strains have been almost completely replaced by crossbreed Hazera 610 in most areas on unirrigated land.

Source: Statistics Division, FAO, Rome.

mostly to save labor. In most underdeveloped countries, the scarcity of capital relative to labor severely limits the economic value of mechanical innovations requiring large capital. Extensive use of such implements, therefore, may be advisable only when they make possible large improvements in quality of the operations performed, or enable performance of production operations that cannot be easily performed with traditional implements.

In countries that have large land expansion potentials, introduction of more tractors and tractor-drawn machinery could facilitate exploitation of land. Even in these countries, however, the scarcity of capital dictates careful weighing of this approach against techniques requiring little capital.

Much progress has been made in recent years in adapting modern farm machinery to the needs of small-scale agriculture. Small garden tractors have been extensively used in Switzerland, France, and West Germany since the late 1940's. Nowhere has their use increased at a faster rate than in Japan, where slightly over 1.4 million were in use in 1961. Since then the number has rapidly increased.

While numbers of tractors and tractor-drawn equipment serve as measures of progress in farm mechanization, surveys indicate that use of even the simple, traditional tools of some regions in other areas may constitute a substantial technological

Table 45.--Seed status of wheat, rice, and cotton, in specified countries, 1964[1]

Commodity and country	Plant breeding	Use of improved varieties	Production of improved seed	Seed certification	Seed testing	Seed distribution	Seed laws	Areas under crop	Area under improved varieties
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Wheat	Rating	Rating	Rating	Rating	Rating	Rating	Rating	1,000 ha.	Percent
Argentina.....	2	2	1	1	1	1	1	3,599	100
Mexico.....	1	1	2	3	3	2	2	840	98
Poland.....	1	1	1	1	1	1	1	1,640	90
Yugoslavia.....	1	1	1	1	1	1	1	2,150	50
UAR.....	2	2	3	3	3	3	5	600	30
Jordan.....	3	3	4	5	4	4	5	225	15
Tunisia.....	1	1	1	1	1	1	1	1,200	100
Turkey.....	2	2	2	2	2	4	2	7,800	35
Pakistan.....	2	2	2	2	2	2	5	4,700	7
Iran.....	3	3	3	4	4	3	4	4,000	10
India.....	2	2	3	5	4	2	5	13,300	44
Netherlands....	1	1	1	1	1	1	1	126	100
Rice									
Argentina.....	2	2	2	1	1	1	1	46	90
Costa Rica.....	1	1	1	3	3	2	3	59	33
Venezuela.....	2	2	4	2	2	2	2	74	90
UAR.....	3	3	3	3	3	3	5	250	35
Pakistan.....	4	3	4	4	4	4	5	9,700	5
Iran.....	2	4	4	4	5	4	4	340	1
India.....	2	2	3	5	4	2	5	35,470	37
Cotton									
Costa Rica.....	2	3	3	3	3	3	3	1	75
Venezuela.....	2	2	3	2	2	2	2	48	90
Yugoslavia.....	3	3	1	1	1	1	1	10	100
UAR.....	1	1	2	3	3	2	4	830	80
Pakistan.....	2	2	2	2	2	2	3	1,400	75
Iran.....	3	3	3	4	4	3	4	300	20
United States..	1	1	1	1	2	1	2	600	90

[1] The ratings 1, 2, 3, 4, and 5 designate excellent, good, fair, poor, and none, respectively. The following criteria were considered by plant scientists when they replied to each of 9 questions asked in the survey:

1. Plant breeding: an appraisal of local breeding facilities for the crop concerned, including experimental stations and institutes, professional staff, and the quality of the work done by the professional staff.
2. Improved varieties: availability of improved varieties, locally bred or imported, ready for commercial use.
3. Seed Production: facilities available to provide commercial quantities of improved seeds. This includes state farms, private farms, cooperatives for seed multiplication, and facilities for processing and storing seed.
4. Seed Certification: an appraisal of existing official organizations specially concerned with supervising seed production by certification schemes.
5. Seed Testing: existing control of seed quality during production process, including an appraisal of seed testing laboratories.
6. Seed Distribution: organization of the method of seed distribution from the breeding station to the farmer.
7. Seed Laws or Regulations: an assessment of the effectiveness of existing laws or regulations relating to seed; (if no laws were in existence, a status rating of zero was given.)
8. Area under crop: latest estimate (in thousand hectares).
9. Area under improved varieties: latest estimate (in percentage of total crop).

Source: Special survey made for ERS, USDA, by FAO, Rome, 1964.

improvement (Mosher, 38). In many of the less-developed countries, shifts from wooden to steel-pointed plows, from steel to rubber-tired wheels, or from sickles to scythes may be major mechanical improvements. Also, change from broadcasting to row planting of crops--including in some cases maize and cotton--has yielded favorable results in several areas. In studies of the economic advantages of drill sowing over broadcasting conducted in India, drill sowing of ragi yielded 19.67 percent more per unit of land than did broadcast planting (Patil, 45). This drilling of seed was done with a "country seed drill," a simple device to help drop the needed quantity of seed in regular lines.

In some instances, farmers' adoption of specific techniques may be retarded if large amounts of labor are required. Even though the country's general labor supply may be plentiful, the added labor represents a cost to the individual farmer, either as a cash expense or as a loss of leisure. If additional labor slows down adoption of production-increasing technologies, then a more rapid movement toward mechanization of a labor-saving type may be indicated.

Research for Improving Technological Bases

Improving the technological bases of agriculture in underdeveloped countries is fundamentally a research task. Much of the research required needs to be carried on within the underdeveloped countries, but facilities there are the most inadequate. For example, in 1960 the number of research workers per 100,000 people active in agriculture was only 1.2 for India, 4.5 for Pakistan, and 4.7 for Thailand, compared with 60 for Japan, 79 for Taiwan, and 133 for the Netherlands (table 46).

These figures are only indicative of existing research limitations. Generally, the less-developed countries have more disadvantages than these data indicate. Research personnel generally have had less training than their counterparts in more advanced nations, and they often work with less adequate facilities and support personnel. Moreover, research takes time for useful results, and in several of the countries research programs have been in operation for only a few years.

In developing research programs, the underdeveloped countries can make use of the large body of fundamental scientific principles and methodological know-how built up in the economically advanced countries over the years. Thus, while rice varieties that have enabled Japan to increase its rice production may not be successfully transferred into India or the Philippines, the basic scientific principles used by Japanese scientists can help develop improved varieties in other countries.

The transferability of such know-how has made it possible for geneticists in Mexico to develop new varieties of wheat that helped to double that country's yield per acre between 1948-52 and 1960-62 (table 38). According to experts in Israel, research has enabled Israeli farmers to increase their yield of cereals from 600 to over 5,000 kilograms per hectare on unirrigated land, and from 3,000 to over 10,000 kilograms per hectare on irrigated land.[7]

The future capacity of the agricultural sectors of underdeveloped countries to increase output will be facilitated by development of improved agricultural research programs. For many problems, optimal use of scarce research resources necessitates the development of regional centers to serve several countries, in the manner being done by the International Rice Research Institute in the Philippines. While basic research requires continuing attention, considerable efforts need to be concentrated on applied research within individual countries (Sukhatme, 61).

Table 46.--Agricultural research workers per 100,000 people active in agriculture, 14 countries, 1960

Country	Agricultural research workers	Country	Agricultural research workers
	Number		Number
India	1.2	Iran	10
Philippines	1.6	Greece	10
Mexico	3.8	Argentina	14
Pakistan	4.5	Yugoslavia	29
Thailand	4.7		
		Japan	60
Colombia	9	Taiwan	79
Spain	10	Netherlands	133

Sources: Directory of Agricultural Research Institutes and Experiment Stations in Asia and the Far East, FAO, Bangkok, 1962, and FAO questionnaires to perspective governmental Inventory of Information Basic to the Planning of Agricultural Development in Latin America, CIDA, Pan American Union, Washington, D.C.

[7] These estimates were provided by FAO.

CHAPTER 6.--THE HUMAN FACTOR

This section deals with human resource characteristics as factors associated with differences in levels and rates of change in agricultural output and productivity in the study countries. Its emphasis is on population and population characteristics as a source of supply of labor and entrepreneurship. Population is also important as a source of demand for goods and services, but this aspect will be treated in Chapter 8.

Together, the 26 study countries account for more than 1 billion of the world's 3 billion people and for about 75 percent of the population in countries assisted by the AID. India alone has almost a sixth of the world's people. Pakistan, Japan, and Brazil rank among the 8 leading countries of the world in population size (table 47). With the exception of Japan, most of the population in these countries is rural (table 48).

Table 47.--Population size, density, and growth rates in the 26 study countries, by size of population, specified years

Country	Total population, 1960	Population per square kilometer of area, 1961	Population growth rate, 1950-60
	Millions	Number	Percent
India	429.0	138	2.0
Pakistan	92.6	100	2.2
Japan	93.2	254	1.2
Brazil	71.0	9	3.1
Nigeria	35.1	39	3.7
Mexico	35.0	18	3.1
Spain	30.3	61	0.8
Poland	29.7	96	1.8
Turkey	27.8	37	2.9
Philippines	27.4	96	3.2
Thailand	26.4	53	3.2
UAR	26.0	27	2.4
Iran	20.2	13	2.2
Argentina	20.0	8	1.7
Yugoslavia	18.4	73	1.1
Colombia	14.1	13	2.2
Sudan	11.8	5	3.4
Taiwan	10.6	305	3.4
Tanganyika	9.2	10	1.8
Greece	8.3	64	1.0
Venezuela	7.4	8	4.0
Chile	7.7	11	2.5
Tunisia	4.2	34	1.8
Israel	2.1	106	5.2
Jordan	1.7	17	2.6
Costa Rica	1.2	24	3.9

Source: Demographic Yearbooks, United Nations.

Table 48.--Rural population, 26 study countries arrayed by size of total population, 1950 and 1960

Country	Total population, 1960	Rural population				
		1960		1950		1960 as a percentage of 1950
		Size	Percentage of total population	Size	Percentage of total population	
	Millions	Millions	Percent	Millions	Percent	Percent
India.....	429.0	353.6	81.9	293.2	82.8	121
Pakistan.....	92.6	84.2	87.2	69.8	89.9	121
Japan.....	93.2	34.0	36.9	51.8	62.5	66
Brazil.....	71.0	39.0	54.9	33.4	63.8	117
Nigeria.....	35.1	NA	NA	NA	NA	NA
Mexico.....	35.0	17.2	49.1	14.8	57.4	116
Spain.....	30.3	22.2	73.0	17.7	63.0	125
Poland.....	29.7	15.4	51.9	20.8	83.9	74
Turkey.....	27.8	19.0	68.3	16.4	78.1	116
Philippines....	27.4	NA	NA	14.9	73.1	NA
Thailand.....	26.4	23.2	88.2	17.3	90.5	134
UAR.....	26.0	16.2	62.5	13.9	68.0	117
Iran.....	20.2	NA	NA	13.0	80.0	NA
Argentina.....	20.0	NA	NA	NA	NA	NA
Yugoslavia.....	18.4	NA	NA	13.2	82.9	NA
Colombia.....	14.1	NA	NA	7.2	63.7	NA
Sudan.....	11.8	NA	NA	NA	NA	NA
Taiwan.....	10.6	NA	NA	3.5	46.2	NA
Tanganyika.....	9.2	NA	NA	NA	NA	NA
Greece.....	8.3	4.8	57.8	4.8	63.9	100
Venezuela.....	7.4	2.4	32.4	NA	NA	NA
Chile.....	7.7	2.4	32.9	2.2	38.3	109
Tunisia.....	4.2	NA	NA	NA	NA	NA
Israel.....	2.1	0.3	14.3	0.2	17.7	150
Jordan.....	1.7	0.9	56.2	0.8	64.4	112
Costa Rica.....	1.2	0.8	66.7	0.6	66.5	133

Source: Demographic Yearbooks (1963 and earlier years), United Nations.

Population Size and Agricultural Output

The importance of a country's population as a source of supply of labor and entrepreneurship depends both (a) upon its size relative to the supply of other complementary resources, and (b) upon qualitative characteristics of the population which influence labor capacity and work participation.

The size of a country's labor force influences its per capita agricultural output because of applicability of the principle of diminishing returns, or more accurately, the principle of variable proportions. According to this principle, output per worker varies with changes in the number of persons who work a given area of land, other things remaining unchanged. These variations follow a three-stage pattern: (1) the stage in which output per person increases as population increases; (2) the stage in which output per

worker decreases with increases in population, but in which the marginal output of labor is positive and total output increases with increases in number of workers; and (3) the stage in which total output decreases with increases in number of workers.

Agricultural rather than total population is the more relevant statistic for examining the operation of this principle as it applies to agricultural production. Precise measurement of the influence of size of a country's agricultural population upon its agricultural output would require knowledge of the contours of the curves relating output to changes in intensity of labor use. The closest approximation to such information now available for the study countries is that provided in statistics on hectares of arable land and value of agricultural output per agricultural worker (table 49). This information would be fully adequate for such purposes if the schedules relating output per worker to changes in number of workers per unit of land were approximately alike for all countries. But the contours of such schedules vary from country to country, depending upon differences in soils and climate, level of adaptable farm technology, price elasticities (applicable when output is measured in value terms), amount of capital per unit of land, and other factors.

Table 49.--Value of agricultural output per agricultural worker and per hectare of arable land, 23 study countries, specified years

Country[1]	Total agricultural workers, 1960	Agricultural workers per 100 hectares of arable land, 1960	Agricultural output, 1960		Changes in agricultural output per agricultural worker, 1950-60
			Per agricultural worker	Per hectare of arable land	
	(1)	(2)	(3)	(4)	(5)
	Thousands	Number	-------U.S. dollars--------		Percent
Argentina.....	2,161	4.9	1,080	78	NA
Chile.....	646	11.8	547	59	NA
Jordan.....	134	14.7	NA	NA	NA
Tunisia.....	971	18.5	NA	NA	NA
Iran.....	3,743	22.2	NA	NA	NA
Spain.....	4,803	22.7	656	150	NA
Mexico.....	5,948	24.4	369	110	NA
Venezuela.....	751	31.2	500	150	NA
Israel.....	122	33.3	1,825	557	33
Turkey.....	9,737	38.5	326	127	NA
Poland.....	6,541	41.7	616	252	NA
Colombia.....	2,544	52.6	531	270	1
Greece.....	1,940	52.6	391	205	48
Yugoslavia.....	4,693	55.6	250	141	NA
Costa Rica.....	214	71.4	438	320	NA
Brazil.....	13,555	71.4	229	104	10
India.....	128,214	83.3	114	91	NA
Pakistan.....	18,636	83.3	182	133	NA
Philippines.....	5,383	83.3	181	139	NA
Thailand.....	11,334	111.1	94	106	NA
Taiwan.....	--	166.7	228	477	50
UAR.....	4,403	166.7	365	643	NA
Japan.....	14,346	250.0	402	961	76

[1] Ratio of workers to arable land not ascertained for Nigeria, Sudan, and Tanganyika because of inadequate statistics on land area or number of agricultural workers.

At best, therefore, international comparisons can provide only crude indicators of the influence of size of agricultural population on output and productivity. The range of possible influences would be appreciably narrowed if we could assume that none of the study countries were now operating under conditions either of increasing average returns, or of zero or negative marginal returns in the application of labor to land. If this assumption is tenable, it means that none of the countries could increase its output per agricultural worker merely by increasing the number of workers, and that none could increase its total agricultural output merely by reducing the size of its agricultural population. Rather, all of the study countries would be operating under conditions of decreasing average yet positive marginal returns with respect to the size of their agricultural population relative to agricultural land.

Among the study countries, there is a tendency for output per worker to be highest in countries where the number of workers relative to area of arable land is lowest. This tendency is not highly consistent, however. Argentina, for example, has the fewest agricultural workers relative to arable land and ranks second among the 26 countries in value of output per farm worker (table 49). Israel, on the other hand, ranks tenth among countries reporting arable land per worker, but is the leading country in value of agricultural output per worker. Japan leads the study countries in number of agricultural workers per hectare of arable land, but it ranks ninth in value of agricultural output per agricultural worker. This low value is partly offset by the relatively large importance of nonfarm work as a source of employment and income for Japanese farm workers.

Population has been increasing in all of the study countries since 1948 at annual compound rates ranging from less than 1.0 percent in Spain to more than 3.0 percent in Israel, Venezuela, Brazil, Taiwan, Thailand, the Philippines, Mexico, Nigeria, and Sudan (table 47). Assuming a positive, instead of a zero or a negative, marginal productivity of labor, the associated increases in agricultural population have contributed to increasing total agricultural output in all of the study countries. A few countries, principally in South America and Africa, have been able--because of their farmland expansion potentials--to accommodate increases in agricultural population with little decrease from the output per worker that they might otherwise have had. A few of these countries still have an underutilized land-expansion potential large enough to absorb their probable farm population increases for another decade or more without incurring sharp decreases in output per worker. To do this, however, will probably require the building of an infrastructure of roads, schools, electric power facilities, etc., in newly developing areas somewhat comparable to those in already developed areas. It will thereby place heavy demands upon scarce capital.

More densely populated countries, such as Taiwan and India, can accommodate increases in their agricultural population and labor force mainly by increasing the intensity of labor use on land already in highly labor-intensive uses. Most of these countries have averted decreases in output per worker largely through technical improvements, land development (as by irrigation and drainage), and increased capital investments (tables 6 and 49).

Economically Active Population

Generally, countries with a large portion of the labor force in agriculture and low per capita income levels have a large percentage of their population in the economically active category (table 50). Work participation by children and elderly persons is usually high in less-developed countries. In the Philippines, 5 percent of the male labor force is under 15 years of age, but in Japan, the proportion is negligible. Relatively high work participation rates are associated with a predominance of the agricultural sector in the economy, low school enrollment ratios, and little social legislation.

Table 50.--Percentage of population in the agricultural, economically active categories, and under 15 years of age, selected countries and years

Country[1]	Year	Percentage of--			
		Population in agriculture	Total population economically active	Economically active population in agriculture	Total population under 15 years of age
Group I		Percent			
Israel	1961	[2] 18	35	18	36
Sudan	1956	87	47	80	[3] 43
Mexico	1960	58	32	54	44
Costa Rica	1950	NA	34	55	43
Philippines	1961	[4] 69	37	58	46
Tanganyika	1948	NA	NA	NA	45
Yugoslavia	1961	50	45	57	31
Taiwan	1962	[5] 50	32	[5] 50	[6] 46
Turkey	1960	[7] 72	47	75	41
Venezuela	1961	31	32	32	45
Thailand	1960	[2] 66	53	82	43
Brazil	1950	NA	33	58	42
Greece	1961	[8] 52	48	49	27
Group II					
Iran	1956	[9] 60	32	55	42
India	1961	[10] 70	43	70	[10] 37
Poland	1960	38	47	47	34
Argentina	1960	20	38	19	30
Chile	1960	[11] 38	32	28	40
Japan	1960	38	47	33	[12] 29
Spain	1960	[2] 48	38	41	27
Colombia	1951	[9] 46	33	54	43
Nigeria	1952-3	NA	[13] 48	NA	[13] 44
UAR	1960	[14] 62	30	57	43
Pakistan	1961	[10] 92	34	[15] 65	45
Tunisia	1956	NA	34	68	41
Jordan	1960	NA	24	35	[2] 44

[1] Countries are arranged in descending order according to annual compound rates of change in crop production. [2] 1950. [3] Under 12 years of age. [4] 1948. [5] 1956. [6] 1961. [7] 1945. [8] 1949. [9] 1960. [10] 1951. [11] 1940. [12] 1962. [13] Indigenous population only. [14] Estimate. [15] 1954-56.

Source: FAO, Production Yearbook, and International Labor Organization (ILO), Yearbook of Labour Statistics.

The economically active population as a percentage of total population has been declining relative to the increase in total population in most of the study countries (table 51). Exceptions include Chile, Mexico, Pakistan, and Thailand where the ratio increased in spite of an increase in the population under 15 years of age. The aging of the populations is a partial explanation for the relative increase in the economically active populations of Greece and Japan. Changes in definition of economically active population also account for some of the variations reported.

Table 51.--Recent percentage changes in total economically active and agricultural populations, selected countries and years

Country[1]	Period	Change in total population	Changes in economically active population	
			Total population	Agricultural population
Group I	Years	Percent		
Israel	1952-61	52	42	NA
Mexico	1950-60	35	36	27
Philippines	1948-61	36	31	16
Yugoslavia	1953-61	10	6	-9
Taiwan	1956-62	23	17	NA
Turkey	1950-60	33	3	-9
Venezuela	1950-61	49	41	10
Thailand	1947-60	51	54	49
Brazil	1940-50	26	22	5
Greece	1951-61	10	[2] 14	[2] -4
Group II				
India	1951-61	23	[3] 35	[3] 34
Poland	1950-60	19	12	-8
Argentina	1947-50	28	18	-10
Chile	1952-60	24	26	5
Japan	1950-60	12	21	-17
Spain	1950-60	9	8	-9
Colombia	1938-51	29	-18	-39
UAR	1947-60	36	20	7
Pakistan	1951-61	22	35	NA

[1] Countries arranged in descending order according to annual compound rate of change in crop production during the period 1948-1963.

[2] Estimate.

[3] The 1951 and 1961 data are not strictly comparable. The definition of economically active population was changed in the 1961 census.

Source: FAO, Production Yearbook, and ILO, Yearbook of Labour Statistics.

Qualitative Factors Affecting Supply of Labor

A country's supply of labor is a function not only of the size of its population, but also of qualitative attributes. These include nutritional and health levels, kinds and levels of education, and traditions, mores, and social patterns which proscribe particular kinds of work or influence the values placed upon material welfare, work, and nonwork activities.

Health Conditions

No fully adequate measures of differences among the study countries in health conditions are available. Infant mortality rates and percentages of deaths occurring at age 50 and older are among the better available indicators; they reflect differences in medical services, sanitation, incidence of disease, nutritional levels, and living and working conditions. These two indicators have been used for rating general health conditions in the study countries (table 52).

Table 52.--Indicators of health conditions, 26 study countries arrayed by per capita gross national product and output per farm worker, specified years

Country	Per capita gross domestic national product, 1960	Agricultural output per farm worker, 1960	Infant mortality rates, per 1,000, 1955-59	Percentage of deaths at age 50 and over, 1960	Health rating[1]
	U.S. dollars		Number	Percent	Rating
Israel	905	1,674	[2] 32	[2] 71	1
Venezuela	650	498	64	34	2
Poland	538	616	75	66	1
Argentina	465	1,598	60	59	1
Chile	405	545	118	[3] 38	2
Spain	372	656	52	[3] 74	1
Japan	337	402	38	73	1
Mexico	321	358	78	[3] 29	2
Greece	297	387	41	76	1
Turkey	254	326	NA	[3] 36	2
Costa Rica	251	438	79	31	2
Colombia	248	536	101	28	3
Yugoslavia	179	249	99	[3] 58	1
UAR	155	365	130	[4] 27	3
Jordan	153	NA	70	28	2
Tunisia	145	NA	[5] 44	[4 5] 63	1
Brazil	145	229	[6] 170	[4] 21	3
Philippines	113	181	83	29	2
Taiwan	97	247	34	NA	1
Nigeria	95	NA	78	NA	3
Thailand	84	94	55	[3] 29	2
India	70	113	[8] 146	[4] 26	3
Sudan	66	NA	94	NA	3
Pakistan	64	165	[9] 107	NA	3
Tanganyika	57	NA	[7] 170	NA	3

[1] The numbers 1, 2, and 3 denote most favorable, moderately favorable, and least favorable health conditions, respectively. [2] Jewish population only. [3] 1957-59 period. [4] 1950-52 period. [5] European population only. [6] 1940-50 period. [7] 1945-49 period. [8] For rural areas only. [9] 1951-54 period.

Source: United Nations (55).

Generally, countries with the highest levels of agricultural output per agricultural worker had the most favorable health conditions. The 5 leading countries in this category were Israel, Argentina, Spain, Poland, and Chile. Of these, all except Chile were in the most favorable category. The 6 lowest countries in output per worker were Thailand, India, the Philippines, Pakistan, Brazil, and Taiwan. Of these, India, Pakistan, and Brazil were in the least favorable class; Thailand and the Philippines were in the moderately favorable class; and Taiwan was in the most favorable class. In Taiwan, large-scale, aggressive health and sanitation programs sponsored by the central government and supported by large numbers of the population have been major factors in improving general health conditions. Taiwan's experiences indicate that despite low incomes, health conditions can be improved in countries that have the will to do so.

In recent years, health conditions have improved in most of the study countries. This is reflected by the decline in infant and childhood mortality, and in infectious and parasitic

diseases. Most of the countries, however, still have very inadequate housing, sanitation, and medical facilities.

In spite of recent progress, large numbers of people in underdeveloped countries are still affected by infectious and parasitic diseases. Approximately one-sixth of the world's population is afflicted with trachoma, a disease causing blindness. In some tropical countries, malaria is still widespread, and the incidence of tuberculosis is second only to malaria. Pestilential diseases, such as smallpox, plague, cholera, yellow fever, typhus, and relapsing fever, most frequently occur in the world's tropical and semitropical regions; however, incidence of these diseases has been greatly reduced during recent years as a result of large-scale eradication programs.

State of health is a function of environment and nutrition as well as of medical facilities. The elimination of disease carriers is an important approach to eradicating parasitic diseases. For example, two-thirds of Tanganyika is uninhabitable because of the tsetse fly. Its elimination would reduce the incidence of disease and open up new lands for cultivation. Such measures often must be accompanied by improvements in environmental factors. For example, water is the carrier of a snail-causing bilharziasis, a debilitating disease which affects an estimated 150 million people in rural areas. Improved sanitation will be necessary to eliminate the disease.

Undernutrition (insufficient calorie intake) and malnutrition (imbalance in the diet) often account for lethargy, lack of initiative and drive, low resistance to disease, and quick tiring at work (table 53). Improvements in nutrition will also increase employment capacities of rural people in the world's less-developed countries.

Table 53.--Calorie levels as percentages of requirements and protein consumption per capita, 17 study countries, 1957-58 - 1959-60[1]

Country[2]	Calorie level	Protein level (per capita)	
		Total	Animal origin
	Percent	Grams	Grams
Israel	110	81	33
Mexico	100	68	20
Philippines	85	47	14
Yugoslavia	111	95	26
Taiwan	102	57	14
Turkey	117	90	14
Venezuela	92	62	25
Brazil	112	[3] 67	[3] 19
Greece	120	93	26
India	84	52	6
Argentina	120	98	57
Chile	99	[3] 77	[3] 26
Japan	74	67	17
Spain	104	71	20
Colombia	88	[4] 48	[4] 23
UAR	108	76	13
Pakistan	88	46	7

[1] Calorie and protein levels are generally much lower in rural than in urban areas.

[2] Countries arranged in descending order, according to annual compound rates of change in crop production.

[3] 1957.

[4] 1956-58.

Sources: The World Food Budget 1970, Foreign Agr. Econ. Rpt. 19, U.S. Dept. Agr. Oct. 1964, and United Nations (55).

Educational Levels and Programs

Development of human knowledge and skills is an essential component of economic progress. No other factor has contributed more to man's growing capacity to increase his output of goods and services. The world's economically advanced nations have long assigned high priority to increasing knowledge through research and to increasing the level of education and skills of all of their people. Therefore, these nations stand in sharp contrast to the world's less-developed nations in levels of education and skills (fig. 9), and in size of the stock of knowledge applicable to increasing production, especially in agriculture.

Although available statistics on educational levels in many study countries are in some ways restricted, indicators as illiteracy rates, educational attainments of those 25 years of age and over, and percentage of children in eligible ages enrolled in school (table 44) have considerable value. A composite index of primary and secondary school enrollment in 1950 has been used for rating the countries according to the educational levels of their present adult population and for classifying them into the three groups, most favorable, moderately favorable, and least favorable (table 54).

All of these indicators relate to the total population rather than to the rural or agricultural sector. Educational levels in rural areas are consistently lower than in urban areas. For instance, only 3 children in the rural areas of Brazil for every 100 in urban areas completed 5 years of schooling. In the Philippines, 84 percent of the 7-to-13 age group in urban areas, compared to 68 percent in rural areas, attended school in 1957. Factors associated with the rural-urban education differential include sparsity of population, inadequate transportation, unwillingness of qualified teachers to live in rural areas, and reluctance of families to forego the assistance of children at home. Moreover, many families in rural society do not appreciate education because of the seeming inapplicability of knowledge gained through schooling. Lack of facilities for secondary and higher education lessens the appreciation of even primary education.

Among study countries, higher education levels are generally associated with higher per capita incomes, higher productivity, and more rapid growth of per capita agricultural production. Countries with an education rating of 1 have an average per capita GNP of $437, output per worker of $641, and 2.1 percent annual change in per capita crop production. The relevant figures for countries with a rating of 2 are, respectively, $221, $336, and .9 percent. For countries with a rating of 3, the relevant figures are $123, $240, and 1.1 percent.

There are numerous exceptions to the above general relationships, particularly among countries with ratings of 2 and 3. The per capita GNP in Costa Rica, with a rating of 2, is $438; in Greece, with a rating of 1, it is $387. The rapid growth of Sudan and Tanganyika probably reflects production on commercial farms where good management has probably substituted for low educational levels. Moreover, while a highly developed economy may require a relatively high level of education, a high educational level will not assure a rapid rate of economic growth unless other requisites for development are favorable. Rather, educational levels can be in part a function of income levels such that a rise in income, associated with an increase in productivity, often finances educational expansion (Bowman, 6). These considerations raise questions concerning the proper investment priority assignable to education. It has often been held that a large expansion of educational facilities is a prerequisite of sustained growth. An alternative hypothesis is that educational expansion is inseparably linked with growth as both product and contributor. Needed levels and rates of expansion of education depend in part on the levels of development already achieved. A goal of universal education through the elementary school level, coupled with enough progress in higher levels of education to service such an expanded elementary school program, would be an exceedingly ambitious goal for most of the study countries.

The quality of education in many of the study countries is low by Western standards. Often, school curricula at all levels of instruction are characterized by excessive work loads and emphasis on detail. Teaching methods are rigid, with emphasis on memorization rather than on developing a spirit of inquiry and power of observation. Class instruction often bears little relationship to everyday experience. Such characteristics

LITERACY RATE*, 26 COUNTRIES

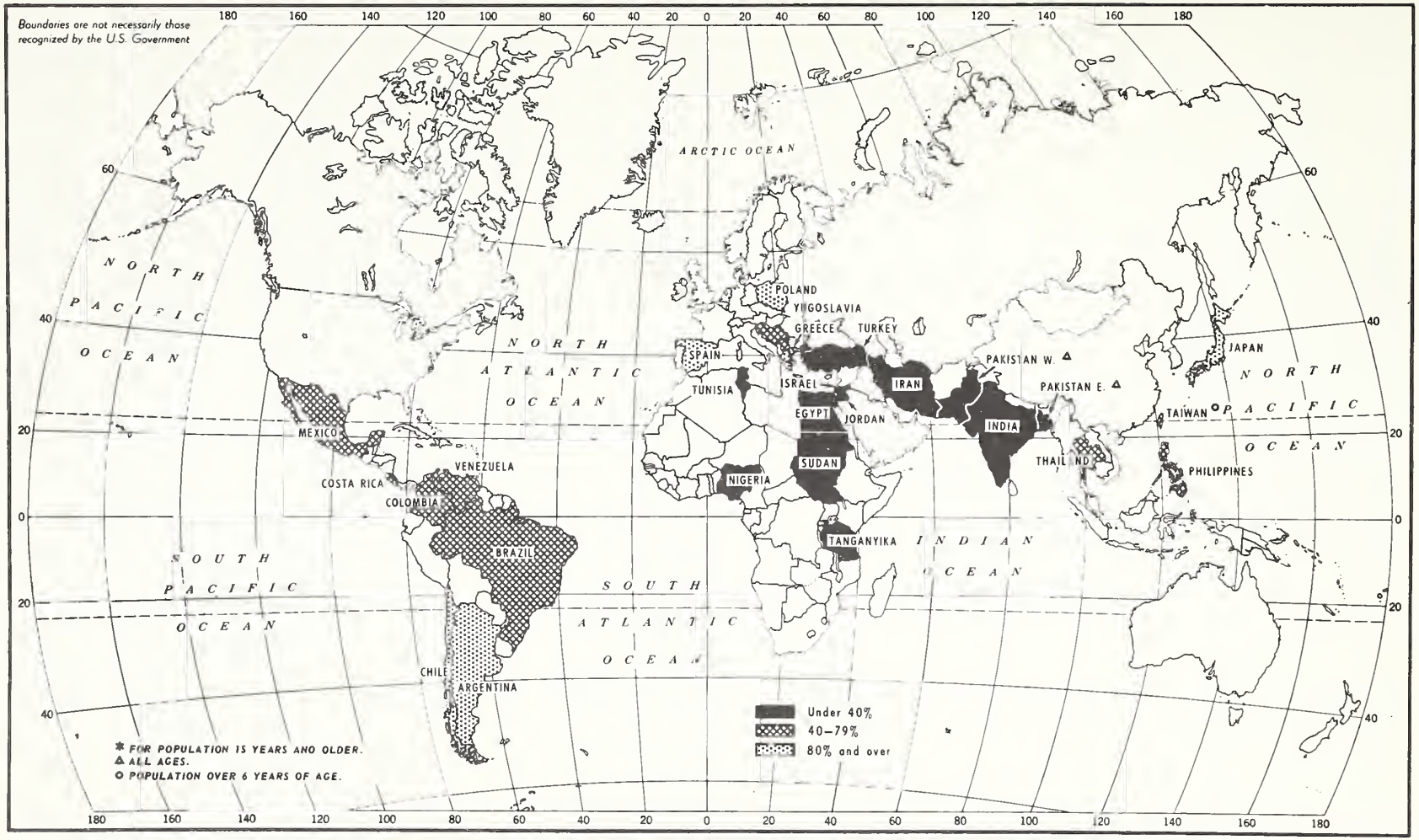


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Figure 9

Table 54.--Indicators of educational levels, 26 study countries arrayed by per capita gross national product

Country	Annual compound rate of change in crop output, 1948-63	Literacy rate[1]	Percentage of population 25 years and older, by level of schooling completed[2]				Percentage of children in primary and secondary schools, 1950	Education rating[3]
			Less than first level	First level	Second level	Third level		
	---Percent---							Rating
Israel	9.7	96	[4] 43	[4] 32	[4] 21	[4] 4	58	1
Venezuela	4.5	52	NA	NA	NA	NA	30	2
Poland	3.0	95	52	35	10	3	53	1
Argentina	2.8	86	[5] 38	[5] 57	[5] 4	[5] 1	51	1
Chile	2.8	80	24	55	19	2	50	1
Spain	2.7	87	[6] 28	[6] 67	[6] 4	[6] 1	43	1
Japan	2.8	98	3	66	25	6	69	1
Mexico	6.3	65	[7] 40	[7] 53	[7] 5	[7] 2	30	2
Greece	3.7	80	[8] 45	[8] 44	[8] 9	[8] 2	53	1
Turkey	4.5	39	[7] 83	[7] 12	[7] 4	[7] 1	24	3
Costa Rica	5.6	79	63	33	3	1	37	2
Colombia	2.6	62	53	40	6	1	22	3
Yugoslavia	5.1	77	[9] 37	[9] 51	[9] 11	[9] 1	51	1
UAR	2.0	20	NA	NA	NA	NA	20	3
Jordan	-1.9	32	NA	NA	NA	NA	15	3
Tunisia	1.6	16	NA	NA	NA	NA	15	3
Brazil	4.2	49	80	16	3	1	21	3
Iran	3.6	15	94	5	1	--	13	3
Philippines	5.2	75	[10] 70	[10] 25	[10] 2	[10] 3	59	2
Taiwan	4.5	[11] 54	57	34	5	4	38	2
Nigeria	2.6	11	NA	NA	NA	NA	12	3
Thailand	4.4	68	61	36	3	--	38	2
India	3.1	24	[8] 97	[8] 2	[8] 0.5	[8] 0.5	19	3
Sudan	8.0	7	[5] 89	[5] 10	[5] 0.5	[5] 0.5	4	3
Pakistan	1.8	[6] 19	91	6	2	1	17	3
Tanganyika	5.2	7	NA	NA	NA	NA	7	3

[1] For population 15 years and older.
[2] The first level includes those completing 4 years of primary schooling but less than 4 years of secondary school; the second level includes those completing 4 years of secondary but less than 4 years of higher schooling; and the third level includes those completing 4 or more years of higher schooling.
[3] These are based on ratio of primary and secondary school enrollment to size of population in eligible school enrollment ages in 1950. Countries with ratios of 40 percent or more are rated 1, those with ratios of 30 to 39 percent are rated 2, and those with ratios under 30 percent are rated 3.
[4] 1954. [5] Population over 20 years of age. [6] All ages. [7] 1950. [8] 1951. [9] Population over 10 years of age. [10] 1948.
[11] Population over 6 years of age.

Source: United Nations (55).

have encouraged unqualified acceptance of instruction and have stymied the creativity needed for progress.

One measure of the effort being made by governments to improve education is per capita expenditure on education as a percent of per capita GNP (table 55). These range from 1.0 percent in Spain to 5.5 percent in Japan. They are low in Mexico, Pakistan, Greece, India, Colombia, Nigeria, and relatively high in Taiwan, Tanganyika, and the United Arab Republic.

Population growth, inadequate transportation and communication, and variations in language and dialect (as in India, the Philippines, and most of Africa) represent significant barriers to educational progress. But in spite of these obstacles, during the past decade primary enrollment ratios increased in all of the study countries except Greece, Poland, and the Philippines.

Primary and university levels of instruction have generally dominated the educational systems of developing countries. Provisions for vocational and technical training are usually considered inadequate, particularly in view of the great need for technicians in most underdeveloped countries. The United Arab Republic and Israel are exceptions.

There is often little demand for vocational schooling among students, just as there is little demand for technical subjects in secondary schools of general instruction or in universities. Prestige is primarily, if not exclusively, associated with highly academic

Table 55.--Expenditure on education as a percentage of per capita GNP, and distribution of expenditure, 24 study countries

Country[1]	Total educational expenditure	Percentage distribution of expenditure, 1956-59			
		Pre-primary and primary education	Secondary education	Higher education	Administration and other expenses[1]
Group I	Percent				
Israel[2]	[3] 3.0	66.0	9.4	8.0	16.6
Sudan	NA	42.4	39.9	--	17.7
Mexico[2]	[4] 1.1	NA	NA	NA	NA
Costa Rica[5]	3.1	NA	NA	NA	NA
Philippines	2.7	83.8	15.6	.5	0.1
Tanganyika	3.4	44.0	43.6	5.6	6.8
Yugoslavia[2]	3.0	59.7	23.1	16.5	0.7
Taiwan[2]	3.4	NA	NA	NA	NA
Turkey[2]	[4] 2.2	NA	NA	NA	NA
Venezuela[2]	[3] 2.1	NA	NA	NA	NA
Thailand[2]	2.5	65.5	24.5	2.9	7.1
Brazil	2.3	39.1	20.2	24.3	16.4
Greece[2]	[4] 1.6	NA	NA	NA	NA
Group II					
India[2]	[4] 1.7	32.1	35.2	18.0	14.7
Poland	4.2	NA	NA	NA	NA
Argentina[2]	3.1	NA	NA	NA	NA
Chile[2]	[4] 2.4	NA	NA	NA	NA
Japan	5.5	32.0	30.6	11.8	25.6
Spain[2]	[3] 1.0	61.0	6.9	12.1	20.0
Colombia	1.9	43.6	19.6	16.4	20.4
Nigeria[6]	1.9	64.4	23.0	1.5	11.1
UAR	[4] 3.9	NA	NA	NA	NA
Pakistan	1.3	33.0	36.5	16.1	14.4
Tunisia	NA	56.6	[7] 27.6	4.4	11.4

[1] Includes special and adult education among others. [2] Capital expenditure not included.
[3] Expenditure by central government only. [4] Expenditure by Ministry of Education only.
[5] Not known whether capital expenditure included. [6] Not including Southern Cameroons.
[7] Includes teacher training.

Source: UNESCO (63).

subjects, such as the humanities and the fine arts. These subjects are emphasized as preparation for the professions of law, medicine, and civil service, which are highly esteemed because of their association with the governing class. Moreover, students concentrating in a technical subject, such as agriculture, often plan to enter the civil service in an administrative capacity upon graduation. In 1958, Brazil's agricultural schools at the secondary level had a capacity of 20,000 but an enrollment of 5,000, while university level enrollment in agriculture was only 57 percent of capacity (UNESCO, 63). At the same time, unemployment among the professionals is uncommonly high in some countries, notably India and the Philippines. Unemployed university graduates often refuse to seek employment in a field in which they did not specialize.

The quality of university graduates, especially of those who become administrators, is crucial to developing countries. The developing countries have less need for large numbers of mass-produced college graduates than for a smaller number of men of highest quality (Hunter, 27).

Agricultural Extension

Agricultural extension or technical assistance programs to help farm people learn and apply improved ways of farming, better business practices, and more effective patterns of cooperation have made vast contributions to agricultural development in the United States, Japan, and a few other countries. These programs have also contributed directly to expanding the intellectual horizons, knowledge, and skills of farm people.

Until recent years, several of the study countries had no agricultural extension programs, but most of them have now begun to develop this kind of education (table 56). In some cases these programs have emerged as projects supported by AID, FAO, or private foundations. In general, such programs have been in operation for too little time

Table 56.--Ratios of farm holdings and economically active persons in agriculture to extension workers in selected countries, 1959[1]

Country	Total extension workers	Farm holdings per extension worker[2]	Economically active in agriculture per extension worker
	Number		
Israel	610	38	157
Philippines	1,623	1,010	3,497
Taiwan	884	NA	1,698
Turkey	1,758	NA	5,539
Venezuela	332	749	2,331
Thailand	328	6,438	34,555
Greece	4,851	206	403
Iran	648	NA	5,130
India[3]	48,579	913	2,696
Argentina	544	1,005	4,193
Chile	154	980	4,208
Japan	13,566	[4] 445	728
Spain	206	NA	23,316
Nigeria	950	NA	NA
Jordan	90	1,023	NA

[1] These ratios are merely crude indicators of the adequacy of the supply of extension personnel. The total number of extension workers rather than the number of field workers was used for the computations due to data limitations.

[2] Data for farm holdings pertain to a year around 1950.

[3] Including all community development employees.

[4] Data for farm holdings pertain to 1960.

Sources: C. W. Chang, Extension Education for Agricultural and Rural Development, Bangkok, 1963, FAO, Informe del Centro Sudamericano de Extension Agricola, 1959., U.N. Compendium of Social Statistics: 1963, and reports from AID personnel.

or on too limited a scale to have yet had a large impact upon agricultural production. Moreover, establishment of an effective extension program is no easy task in most of the world's less-developed countries.

Agricultural extension programs are most effective when supported by a large fund and a constantly increasing stock of improved technologies. In the United States and Japan, highly effective agricultural research programs have long assured improved technologies. Some technical improvements produced through this research, such as improved insecticides, can be readily adapted to the agriculture of other countries. Other improvements, such as some of the higher yielding crop varieties, have limited geographic application; mechanical inventions have varying degrees of economic value because countries differ in their relative needs for capital and labor-saving innovations. Such limitations in transferability will limit the effectiveness of extension programs in many of the underdeveloped countries until they also build strong agricultural research programs.

Cultural Patterns and Value Orientations[8]

Cultural factors which influence valuations of material welfare, work, and nonwork activities are generally believed to affect demand for goods and services, availability of resources, incomes, savings, and investments. These include kinship ties and attitudes toward change as influenced by family structure, customs, religion, exposure to economic development via luxury consumer goods, and education. For example, the number of holidays in most countries is influenced by religion. So too are food consumption patterns, health conditions, and the economic worth of particular kinds of food-producing activities.

Investigation of the influence of cultural and value differences upon differences in levels and rates of change in agricultural output and productivity between countries is complicated for several reasons. For one thing, cultural patterns and, in turn, the strength of economic or "capitalist" values often differ markedly from area to area and among various population groups within the same country as well as across countries. Indeed, few nations are without some population groups whose economic motivations or "capitalist" values are relatively strong. These, if they can be identified, provide a basis for the beginnings of development.

Moreover, a particular cultural and value feature can both impede and facilitate progress. This is true for some factors that can simultaneously influence economic development from the point of view of both demand and supply. For example, religious holidays, such as the Christmas season in the Western world, can adversely affect the available supply of labor and yet greatly stimulate development through influence upon wants and market demand for goods.

Finally, cultural patterns and values are qualities that have been formed and modified over time. They are always influencing the direction and rate of development--some through their influence on wants, or on the available supply of labor and other factors, or on both supply and demand. However, instead of being static, or "given," they themselves often become one of the products of the development they help to influence. For example, in the United States attitudes toward child labor have changed markedly since 1800 because of changes in technology, income levels, emphasis upon education, and industry structure. As another example, in parts of India introduction of factories which offer jobs not easily fitted into established job and related caste categories is having considerable influence upon traditional caste relations. Existing caste relations, meantime, influence the variety of operations any worker can perform. If labor were expensive and highly inelastic in its supply, this could easily lead to prohibitive labor costs. However, where labor is very cheap and supply highly elastic, such limitations--although influencing the interpersonal and intergroup distribution of jobs--may have very little influence on labor costs per unit of output and, therefore, little influence on economic development.

[8] This section is a brief summation of an analysis that is still in a preliminary stage.

Study of cultural patterns and values will be most useful for economic analysis if the various ways in which cultural patterns influence development can be related to basic economic categories or terms, such as demand, supply, and scarcity. Also, the economic influence of cultural patterns and values can be best evaluated when examined within the framework of a general theory of development. This will make it easier to distinguish the influence of these factors from that of other factors such as market demand, availability of production requisites, and the availability of adaptable technologies more productive than those now in use. Not even the latter factors are wholly uninfluenced by cultural considerations. Yet, care must be taken lest cultural patterns that are different and that can be markedly changed only between generations are held responsible for limitations of other kinds.

CHAPTER 7.--CAPITAL AND CREDIT

Present Capital Features

Capital on Farms

More than any other feature, differences in capital resources distinguish the agriculture of underdeveloped countries from that of economically advanced regions. When man first began to till the soil many centuries ago, his farm capital consisted of little more than a handful of seeds gathered from forests and open areas, and of broken sticks and stones to break and stir the soil. Farmers in economically advanced countries now use modern machines, highly productive kinds of crops and livestock, and other farm inputs that are the marvels of modern scientific and engineering achievement. Yet, millions of tillers of the soil who live less than a day's travel away from modern agriculture still use only a few simple capital items. For many, these include such implements as crude hoes, blunt-edged axes, hand sickles, and wooden flails. At somewhat higher levels, they include wooden plows, carts or wagons, and donkeys or oxen for drayage and draft purposes. Many of these farmers save their seed from the preceding harvest and use seed stock passed down from one generation to another. They have learned to use both animal and human manure as well as straw and other plant materials as soil amendments. Many, however, have never used chemical fertilizers, pesticides, hybrid seeds, and other modern agricultural inputs.

These attributes of agriculture have been described by several anthropologists, economists, and specialists in other disciplines, but quantitative information on farm capital resources is available for only a few underdeveloped countries (Firth and Yamey, 13). For some of these regions, it is available only for a few small areas or case farms.

Information from the All-India Rural Credit Survey conducted in the early 1950's shows the average value of farm assets of families in the wealthier and poorer halves of the population (46). Assets of families in the upper strata had an average value of 8,376 rupees, equivalent at the exchange rate of 4.7 rupees per dollar to $1,782. In dollar terms, this consisted of $1,199 in land, $337 in buildings and irrigation work, $173 in livestock, $41 in implements and machinery, and $32 in other items. The lower strata families had cultivation assets, in dollar terms, of only $506; of this amount, $297 was in land, $123 in buildings and irrigation work, $68 in livestock, $11 in implements and machinery, and $7 in other items.

Families in the upper strata had annual farm operating expenditures totaling 776 rupees ($165) per family, with 444 rupees ($94) paid in cash and 332 rupees ($71) paid in kind. Those in the lower wealth strata had annual farm expenditures totaling 214 rupees ($45), with 121 ($26) paid in cash and 93 rupees ($20) paid in kind. Cash expenditures in the lower strata included 18 rupees ($4) for seed, 8 rupees ($2) for manure, 29 rupees ($6) for hired labor, 29 rupees ($6) for fodder, and 37 rupees ($8) for other items (46, pp. 830-51).

At the end of 1957, the average farm in Taiwan had total farm assets in U.S. dollars of $3,820 (using the exchange rate of NT $29 = $1 U.S.). Land, averaging 4.05 acres per farm, accounted for $2,983 of this amount, building and other land fixtures for $609, livestock for $117, crop inventories for $68, and farm machinery and implements for $43. Annual farm operating expenses for these farms in 1957 amounted to $343 per farm, with $219 paid out in cash and $124 paid out in kind (Tsui, 62).

In major cocoa producing provinces of Nigeria, the average family--consisting of 8.6 persons--had an available total land area of 36.6 acres in 1952. Field survey data obtained for 738 families in these provinces indicated an average value of "durable property" of about $550 per family. This included about $55 worth of "business equipment" consisting of farm implement, craft, and transport items. These included cement platforms for drying cocoa, looms and sewing machines, cars, lorries and bicycles, carpenter tools, and guns of hunters, as well as farm equipment. Farm equipment per family had a reported value of only $22. In a few cases, this included imported axes and spades; but in general the farm equipment consisted only of hoes, broad heavy knives called machetes or cutlasses, knives attached to long poles for harvesting cocoa pods from the higher branches, and a number of large baskets used to carry crops and other goods between farm and home and between home and market (Galletti, Baldwin, and Dina, 20, pp. 133-233). In addition to their "durable property," the average family had about 5 head of sheep or goats and 15 fowls.

Japan has achieved a much higher level of output per worker and per unit of land than all other Asian countries except Israel. Assets per Japanese farm in 1958 had an average value in U.S. dollars of $3,465. Of this amount, land accounted for only 25.7 percent, compared with 78 percent in Taiwan. Buildings accounted for $1,586 or 45.8 percent; farm equipment for $144 or 4.2 percent; livestock for $128; and cash on hand and in banks for $564. Farm operating expenses averaged $304 per farm. Some major expense items included fertilizers averaging $70 per farm, tools and equipment $49, feed purchases $43, and maintenance of farm buildings $29 (Yang, 72).

In Israel, average investment per established family farm (excluding land) for 1954-58 at 1954 prices was about $5,900. Of this amount about $3,000 was invested in structures and equipment, $2,550 in livestock, and $350 in orchards (Mundlak, 40). Of the $3,000 in structures and equipment, about $450 was in farm machinery and implements. In 1954, these farms had a total land area of 12.75 acres per farm and an irrigated area of 5.8 acres per farm. This is much more land than is used per family in either Taiwan or Japan.

Estimates have not been compiled for the other study countries, but the amount of capital per farm in most of the study countries probably lies between the extremes reported for India and Israel. Investments per farm are at the lower end of this range in Pakistan, Thailand, and Tanganyika, somewhat higher in Egypt, Sudan, Iran, the Philippines, and Jordan, and higher still in the Latin American countries, with Argentina appearing to have average capital assets per farm in excess of those in Israel. Against these estimates, the average value of farm assets per farm in the United States in 1959 was about $54,000 (64).

Capital in Agricultural Service Facilities and General Infrastructure Features

Modern agriculture requires not only large amounts of capital on farms, but large investments in industries, institutions, and facilities. These include industries engaged in the manufacture of farm machinery, fertilizers, pesticides, pharmaceuticals, and other items; industries engaged in assembly, storage, and processing of farm products; industries engaged in the transport, distribution, and sales of factors and products; irrigation dams and canals; farm credit agencies; agricultural education, extension, and research institutions; and the infrastructure of roads, railroads, harbors, electric power systems, schools, health and sanitation facilities serving both farm and nonfarm sectors.

Measures of the stock of capital wealth used for such industries, institutions, and facilities are not now available even for the United States, let alone for the study countries (Allen, 3). Some indication of major intercountry differences in such investments, however, is provided by statistics on production of fertilizers, miles of hard surface roads (table 76, Chapter 10), and electric power production, and by general information on agricultural marketing facilities.

Among the study countries, Japan is the leading producer of commercial fertilizers and of most of the other indicators of investments in agricultural service facilities. Mexico and Argentina lead the Latin American countries. All of the Asian countries, except Japan and Israel, and all of the African nations have very low investments.

Needs for More Capital

The need for more capital to increase agricultural output can be determined only by close reference to its productivity relative to its costs. The closest approximation to such information available on a national basis is that on capital-output ratios, as shown in table 57 for 11 of the 26 study countries. These data relate average yearly increments of capital to average yearly increases in agricultural output, but they do not account for contributions of other factors to the increased output. Although they are crude measures, they do indicate a relatively high productivity of capital in most of the less-developed countries, and a generally lower productivity in the more developed countries. For example, in Venezuela, Israel, Japan, Egypt, and Greece, the gross marginal productivity of capital was much lower than in Thailand, Pakistan, India, and the Philippines.

Table 57.--Capital-output ratio and related marginal productivity of capital in specified study countries[1]

Country	Capital-output ratio	Marginal productivity of capital[2]	Country	Capital-output ratio	Marginal productivity of capital[2]
Israel.....	3.70	0.27	Greece.....	1.14	0.88
Philippines.....	0.58	1.72	India.....	0.75	1.33
Yugoslavia.....	1.00	1.00	Japan.....	2.33	0.43
Taiwan.....	0.76	1.32	UAR.....	1.49	0.67
Venezuela.....	4.78	0.21	Pakistan.....	0.28	3.57
Thailand.....	0.26	3.85			

[1] These are incremental gross ratios and gross marginal productivity measures.
[2] These are the reciprocals of the capital-output ratios.

Source: FAO, United Nations, 1964.

Estimates of capital productivity shown in table 57 need to be supplemented by measurements which take account of factors besides capital. The measurements in table 57 also reflect mainly the productivity of capital invested in traditional inputs rather than the new kinds of inputs.

In most of the study countries, there is probably very little scope for investing much additional capital per worker or per unit of land in traditional kinds of agricultural input items. Additional capital is needed, however, for new improved kinds of inputs essential to increasing agricultural output, e.g., seeds of improved crop varieties, chemical fertilizers, pesticides, and improved implements. Capital is also required for the manufacture, transport, and distribution of fertilizers, pesticides, and other production requisites; for facilities for the assembly, transport, processing, and distribution of agricultural products; and for irrigation and drainage facilities. At the general overhead level, more capital is needed for roads, railroads, harbor facilities, electric power and telephone systems, printing presses, hospitals and medical facilities, and educational and research facilities.

The amounts of additional capital now needed for these investments cannot be easily estimated, but the sums are known to be large relative to the additions made to the capital stock of these countries within the last decade (table 58).

Table 58.--Annual gross farm capital formation in specified study countries, 1950 and 1960

Country	Gross farm capital formation				Gross capital formation as percentage of value of agricultural output, 1960[1]
	Total		Per hectare of arable land		
	1950	1960	1950	1960	
	Million U.S. dollars		U.S. dollars		Percent
Israel	63	95	217	[2] 244	42
Sudan	5	33	4	11	6
Philippines	25	24	6	4	2
Yugoslavia	70	393	9	47	33
Taiwan	37	48	45	55	11
Venezuela	135	217	52	88	40
Thailand	50	81	5	8	8
Greece	14	109	4	30	14
India	437	2,156	3	13	15
Japan	529	787	104	[2] 129	16
UAR	42	117	18	47	10
Pakistan	58	150	2	6	5

[1] Gross national product originating in agriculture.
[2] Capital formation per hectare of agricultural land was $87 in Israel and $112 in Japan.

Sources: National Statistical Abstracts, FAO questionnaires to respective governments, National Bank Statement, U.N. Yearbook, National Account Statistics.

Ways of Mobilizing More Capital For Agriculture

Underdeveloped countries can mobilize additional capital to invest in agriculture by one or both of two ways: (1) by internal savings out of current production and incomes, and (2) by diversion of capital from other uses and sources.

Internal savings can be made voluntarily by individuals, families, business firms, or other agencies. Or they can be made through forced saving techniques, that is, through new tax levies or credit expansion for capital expenditures sufficient to increase prices and to force reduced consumption of other goods and services. Under the assumption of full employment of resources, an increased rate of savings is possible only by reducing consumption expenditures, whether savings are made voluntarily or are forced. Underemployed and unemployed resources, however, provide a potential base for savings and new capital formation that does not require curtailing output and consumption of other goods and services.

The potentials for savings out of incomes at current levels are relatively low in most of the study countries simply because of their low level of income relative to living needs. Most of the study countries, however, probably have a larger capacity for savings and new capital formation than their per capita incomes and past rates of capital accumulation indicate. For example, even lower income families in many underdeveloped areas of the world use a relatively large part of their income to purchase jewelry or for ceremonial uses (Firth and Yamey, 13). Furthermore, many underdeveloped countries have extremely unequal income distribution; hence, in some cases, small proportions of the population receive very large incomes.

Rents or income from land constitutes a major part of the income of many of the larger income recipients, especially in countries characterized by large concentrations

of landownership, as in much of Latin America and the Middle East. Historically, land income has often been used for support of conspicuously high levels of consumption rather than for new capital formation (Lewis, 33). Yet, through a combination of land tenure and tax reforms, Japan and Taiwan have been able to draw off a large part of such land income for the financing of needed capital improvements (Ogura, 42). Tax systems of most of the other study countries with large concentrations of landownership do not encourage reinvestment of land income.

Whether underemployed resources provide an important base for new capital formation in agriculture and its related infrastructures depends upon how much underemployed resources the study countries have, upon availability of the factors needed as complements of the underemployed resources--including entrepreneurship and organizational resources without which now idle labor and land are of little economic worth.

Some observers doubt that underdeveloped countries have enough underemployed resources, especially labor, to serve as a significant basis for new capital formation. These doubts have originated from the belief that marginal productivity of labor is positive (Viner, 68). Several of the study countries, however, do have relatively large amounts of unemployment. There are also large seasonal variations in the amount of work performed in the agriculture of most underdeveloped countries. This latter fact suggests the presence of more labor potential in off-peak labor seasons than is actually employed. In the United States, throughout most of the 19th century, such labor was frequently employed to build up farm and rural area resources. Examples of comparable patterns of new capital formation with labor that would otherwise have produced very little can probably be found in most of the study countries. For example, using rupees paid for food under the P.L. 480 program, a rural works program has been devised whereby unemployed rural people in East Pakistan and millions of landless people in the Bengal area have been put to work building farm-to-market roads and irrigation works (Harrison, 5, p. A 16).

Actually, as an economic concept full employment has a meaning that is highly relative to price and income levels, and above all else to the values that a nation's people place on economic goals. Through increased awareness of their possibilities, most people--in less-developed and economically advanced nations alike--can work much more effectively than they are accustomed to doing.

Capital can be diverted from hoards, from other production uses, and from foreign sources, as through grants, loans, and investments by foreign entrepreneurs.

Peasant societies have various methods of hoarding wealth. The magnitude of such hoards and their importance in underdeveloped countries cannot, of course, be determined from available information. It can safely be assumed that diversion of sizeable amounts of capital from other production uses to investments in agriculture is not very important in the study countries. By and large, the study countries will have to depend upon their own savings for much of the capital they need to increase their agricultural productivity. During recent years, these have been supplemented by foreign grants and loans under programs of technical and financial assistance, and by investments of industrial and trade organizations from economically advanced nations. Foreign corporations, for example, have made some investments in plants producing fertilizers and other production requisites in a few of the study countries, thereby providing international transfers not only of capital but also of entrepreneurial ability.

Credit Facilities and Practices

Kinds of Credit Agencies

In most societies, decisions to save and to invest are made by different persons. In such cases, it is mainly through credit transactions that savings are made available to investors. The agency and mechanism through which savings are made available to investors may be very simple or very elaborate, often depending upon the country's stage of economic development. At one extreme, savings can be made available to investors directly by savers without intermediary agencies, or at the other extreme, through large-scale banking and credit systems, including those operated by the state.

Table 59.--Percentage distribution of institutional and noninstitutional credit sources, for specified countries and years

Country	Year	Insti-tutional	Non-insti-tutional	Sources of institutional credit			Sources of noninstitutional credit					Total
				Official and semi-official agencies	Commercial banks	Cooperatives	Professional money lenders	Traders	Relatives and friends	Landlords	Others	
		Percent										
Mexico.....	1959	80.0	20.0	27.0	53.0	[1](27.0)	(20.0)	20.0	(20.0)	--	--	100.
Japan.....	1961	71.7	28.3	18.1	2.3	51.3	(16.7)	16.7	(16.7)	(16.7)	11.6	100.
Venezuela.....	1960	45.0	55.0	40.0	5.0	--	(55.0)	55.0	(55.0)	(55.0)	--	100.
Pakistan (West)	1958	27.7	72.3	13.4	--	14.3	1.1	5.1	62.8	0.2	3.1	100.
Thailand.....	1953/57	12.6	87.4	--	--	12.6	16.1	34.5	34.8	1.0	1.0	100.
Philippines....	1957	12.0	88.0	11.0	1.0	(11.0)	42.0	1.0	6.0	39.0	--	100.
Iran.....	1963	10.0	90.0	10.0	--	(10.0)	90.0	(90.0)	(90.0)	(90.0)	--	100.
India.....	1952	7.3	92.7	3.3	0.9	3.1	69.7	5.5	14.2	1.5	1.8	100.
	1961	23.1	76.9	23.1	---	(23.1)	(76.9)	(76.9)	(76.9)	(76.9)	(76.9)	100.
United States..	1960	47.7	52.3	17.3	24.7	5.7	--	(26.7)	25.6	(25.6)	26.7	100.

[1] The figure included in the parenthesis is a total figure, combining credit from several sources; e.g., in Mexico 27 percent total farm credit comes from cooperatives and official and semi-official agencies, while in the Philippines the corresponding pr portion is 11 percent.

Sources:
MEXICO: Edmundo Flores, Tratode Economia Agricola, Fardo de Cultura Economia, Mexico DF, 1961, p. 361.
JAPAN: Abstract of Statistics on Agriculture, Forestry and Fisheries, Japan 1962, Ministry of Agriculture and Fisheries, Tokyo, 1963, p. 59.
VENEZUELA: Financiamemto del Cultivo de la Papa en Venezuela, Ministry of Agriculture and Fisheries, Caracas, June 1960, p. 1
PAKISTAN (West): Udhis Narkswasdi, Agricultural Credit Systems in Certain Countries, Kasetsart University, Bangkok, 1963, p. 50.
THAILAND: Same as for Pakistan.
PHILIPPINES: Same as for Pakistan, p. 50.
IRAN: Abolnasr Mahoi, "Credit for Agricultural Production," paper delivered at Rural Development Symposium, Central Treaty Organization Countries, Teheran, 1963, p. 8.
INDIA: Report on All-India Rural Credit Survey, 1951-52, Vol. 2, Communication from Indian Government, 1961.
UNITED STATES: "A New Look at the Farm Debt Pictures," Federal Reserve Bulletin, Dec. 1962, pp. 1571-88.

Quantitative data distinguishing the kind of credit agencies serving agriculture are available for only a few of the study countries (table 59). These data indicate that noninstitutional agencies are the principal purveyors of credit to farm people in some countries; this category includes relatives and friends, landlords, traders, and persons who are professional money lenders. These agencies especially serve the lower income countries; in India, Pakistan, Thailand, the Philippines, and Iran, more than two-thirds of all loans are made by noninstitutional agencies. In contrast, institutional credit agencies (consisting of cooperatives, commercial banks, and official and semi-official agencies) account for 80 percent of farm loans in Mexico and for 72 percent in Japan. Both of these countries have made substantial economic progress within the last two decades.

Noninstitutional Lenders

The noninstitutional lender draws mainly upon his own personal wealth as the source of his credit funds. He generally serves a relatively small number of producers living in close proximity to each other, all of whom he personally knows. His credit operations are often linked to his role as landlord or trader, and his credit terms often give him ownership of crops, sometimes long before their harvest. Risks of crop failure, and therefore his credit risks, are relatively high because the geographic area within which he operates is too small for failures to be offset by favorable conditions elsewhere. As indicated in table 60 for India, much of the credit the lender extends is granted for nonproductive purposes, such as for marriages and funerals.

Under these circumstances, loans are usually very small and interest rates very high. In one area in the Philippines, for example, interest rates were 60 percent or more on 54 percent of the loans (table 61). They were 200 percent or more on 17 percent of the loans. In Thailand, interest rates were 36 percent or more on 42 percent of the loans. In one district in India, rates were above 50 percent on more than 25 percent of the loans, and 18 percent or more on nearly 50 percent of the loans. In many cases,

both loans and interest payments were made in kind; this factor may be associated with high interest rates that are used to cover large seasonal price variations rather than solely interest charges.

Table 60.--Purposes of borrowing by rural families in India, 1951-52

Purpose of borrowing	Percentage distribution of loan funds			
	Cultivators	Non-cultivators	All families	Average amount per loan
	Percent	Percent	Percent	Rupees
Capital expenditure on farm.....	31.5	6.0	27.8	44.4
Current expenditure on farm.....	10.6	1.1	9.3	14.9
Nonfarm business expenditure.....	4.5	18.5	6.6	10.5
Family expenditures.....	53.4	74.4	56.3	90.1
Construction and repair of houses.	NA	NA	8.1	13.0
Purchase of clothing, etc.....	NA	NA	6.7	10.7
Marriage and death ceremonies.....	NA	NA	20.7	33.1
Medical and education expenses....	NA	NA	4.6	7.3
Litigation charges.....	NA	NA	3.0	4.8
Repayment of debt.....	NA	NA	2.7	4.3
Other family expenditures.....	NA	NA	10.5	16.9
Total.....	100.0	100.0	100.0	159.9

Source: Reserve Bank of India (46).

Table 61.--Range and distribution of annual interest rates on farm loans from private sources in India, Thailand, and Philippines

India - Etawah Nadia District		Thailand		Philippines - Munos District	
Interest rates	Distribution	Interest rates	Distribution	Interest rates	Distribution
Percent	Percent	Percent	Percent	Percent	Percent
None	[1] 29.3	0-15	[1] 8	None	[1] 22
1-5	4.9	16-25	31	1-14	7
5-9 3/8	9.1	26-35	17	15-29	7
9 3/8-12 1/2	1.7	36-45	19	30-59	10
12 1/2-18	--	46-55	10	60-99	15
18-25	2.8	56-75	12	100-199	22
25-50	18.1	76 and		200-299	10
Above 50	27.8	over	1	300 & above	7
Not known	6.4				
XX	100.0	XX	100.0	XX	100.0

[1] Some of these loans are considered as landlord's obligations in tenancy agreements; others are provided by friends and relatives.

Sources: FAO, U.N., from Udhris Narkswasdi, Agricultural Credit Systems in Certain Countries, Kasetsart University, Bangkok, 1963, pp. 37-38; and Amelita R. Montegro, Notes on ACCFA Operations and Development in the Philippines.

Institutional Lenders

In contrast to noninstitutional lenders, in countries where banking and credit system are highly developed, institutional lenders can draw upon the savings of many differe people in many different places; allocate their available credit funds to localities ar uses holding promise of maximum productivity; spread their loan funds over wide geo graphic areas, thereby making risks of crop failure nearly predictable; perform thei services at relatively low costs.

Such ideal agricultural credit systems are most fully approximated in economicall advanced countries. In the United States, federally sponsored agricultural credit program have been developed to supplement and, in part, to serve as standards for the privat sector's banking and lending institutions, many of which serve agriculture.

State-operated or -sponsored agricultural credit systems have been establishe in several of the study countries--Mexico, Japan, Venezuela, Pakistan, the Philippines Iran, India, Turkey, and others. In fact, Japan established a system of agricultural an industrial banks in the 1890's (Ogura, 42); Turkey's national agricultural credit syste was founded in 1888.[9]

Strong agricultural credit systems emerge in large part as the concomitant o economic progress rather than as the product of legislation or governmental orders Nations must have more savings or capital to assemble before they can make loan to their farmers in greatly increased amounts. Japan is one of the few study countrie that has achieved a sufficiently high annual rate of increase in per capita incomes to b able to channel a large, steadily increasing supply of savings into its agricultural secto Israel has developed a strong agricultural credit system chiefly because of its ow rapid agricultural progress and in part because of its advantageous position in inter national capital flows.

In some of the other study countries, most credit agencies emphasize year-to-yea and intergeneration maintenance functions rather than channelling of increasing amount of capital into agricultural sectors.

Most of the loans in the study countries are made on a short-term basis (table 62 Israel, Yugoslavia, Japan, and Colombia are exceptions. As might be expected, loan made from institutional sources are made predominantly for crop production use

Table 62.--Short-term loans made by institutional credit agencies as a percentage of total institutional loans, specified countries and years

Country	Year	Short-term loans as a percentage of total institutional loans	Country	Year	Short-term loans as a percentage of total institutional loans
		Percent			Percent
Israel.....	1961	24	Iran.....	1959	67
Sudan.....	1960	98	India.....	1960	94
Costa Rica.....	1961	95	Chile.....	1957	73
Yugoslavia.....	1959	31	Japan.....	1961	48
Taiwan.....	1957	95	Colombia.....	1961	40
Turkey.....	1963	85	Nigeria.....	1959	94
Venezuela.....	1962	82	UAR.....	1959	79
Greece.....	1961	82			

Source: FAO questionnaires to respective governments, annual reports of state and federal banks and of agricultural development agencies.

[9] Delegation of Turkey. Country Report on Agricultural Credit in Turkey. Conference on Agricultural Development Banking, Cen tral Treaty Organization, Karachi, Pakistan, Apr. 16-20, 1962.

(table 63). In Colombia, however, the stated purpose of 45 percent of the loans made in 1963 was for use in livestock production. Land improvement was the stated purpose of 24 percent of the loans made in Pakistan in 1960.

Table 63.--Stated purposes of institutional credit, selected countries and years

Country	Year	Crop production	Livestock production	Marketing (including processing)	Redemption of old debts	Land purchases	Improvements to land and buildings	Implements and machines	Draft animals	Consumption	Other
		Percent									
hile.....	1963	85.2	3.7	--	--	7.2	(7.2)	3.9	--	--	--
AR.....	1961	82.6	5.1	3.0	--	--	(9.3)	9.3	(9.3)	--	--
hilippines.....	1959	75.0	(75.0)	21.0	--	--	--	(4.0)	(75.0)	(4.0)	4.0
ndia.....	1958	72.6	5.5	3.2	(9.7)	(9.7	2.2	3.6	(9.7)	3.2	9.7
aiwan.....	1957	67.0	(67.0)	21.2	2.5	--	3.8	(4.4)	(4.4)	1.1	4.4
razil.....	1961	55.5	10.0	1.6	--	(10.4)	10.4	13.6	(8.9)	--	8.9
rgentina.....	1960	46.4	(46.6)	--	--	10.6	17.1	22.4	--	--	3.5
olombia.....	1963	38.4	45.4	--	--	2.9	10.6	1.8	--	--	0.9
anganyika.....	1960	32.7	3.7	(32.7)	--	50.4	8.5	4.7	--	--	--
akistan.....	1960	28.0	--	--	--	--	24.0	8.0	40.0	--	--
hailand.....	1959	12.8	--	--	53.4	1.6	10.8	6.1	14.2	1.1	--

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AKISTAN: Mohd Irshad Khan "Development of Institutional Agricultural Credit in Pakistan," The Pakistan Development Review, Vol. iii, Spring 1963, p. 94.
HAILAND: "Loans Advanced by all Credit Societies - by Purpose," Department of Credit Cooperatives.

Table 64.--Average size of farm loans granted by public institutions, specified years, and annual compound change in crop output, 12 countries, 1948-63

Country	Year	Average loan	Annual compound change in crop output (1948-63)
		U.S. dollars	Percent
Brazil.....	1962 (crops)	750	4.2
	1962 (livestock)	1,420	
Venezuela.....	1962	830	4.5
Chile.....	1963	405	2.8
Colombia.....	1963 (crops)	300	2.6
	1963 (livestock)	390	
Argentina.....	1957	300	2.8
UAR.....	1960	140	2.0
Philippines.....	1958-60	130	5.2
Turkey.....	1961	110	4.5
Thailand.....	1961	75	4.4
Nigeria.....	1959	45	2.6
India.....	1959	25	3.1
Iran.....	1959	20	3.6

Sources: FAO questionnaires to respective governments, annual reports of national and commercial banks and cooperative credit associations.

Information from institutional sources indicates the small size of loans; this is to l expected because of the small amounts of capital used on farms in most of the stu countries (table 64). Loans are highest in Latin American countries and lowest Africa and Asian countries. In terms of U.S. dollars, the average size of loans in 19 was only $25 in India and only $20 in Iran.

Institutional credit sources in the study countries have made credit funds availab at rates of interest or costs that are substantially below those charged by noninstitution sources (table 65). Rates in Iran, for example, ranged from 3 to 6 percent; those Nigeria from 4 to 12 percent; and those in Thailand from 6 to 8 percent.

Table 65.--Annual rates of interest on loans from public institutions in selected years, credit per ton of output in wheat equivalents, selected year, and annual compound change in crop output, 1948-63, 24 countries

Country	Year	Rates of interest on loans	Credit per ton of output in wheat equivalents	Annual compound change in crop output (1948-63)
Group I		Percent	U.S. dollars	Percent
Israel	1961	6-10	42.2	9.7
Sudan	1960	6-8	[1] 3.2	8.0
Mexico	1961	9-11	21.5	6.3
Philippines	1962	NA	[1] 34.7	5.2
Tanganyika	1962	7 1/2-8 1/2	NA	5.2
Yugoslavia	1959	2-5	NA	5.1
Taiwan	1962	NA	NA	4.5
Turkey	1961	7-10	7.7	4.5
Venezuela	1960	3-6	22.0	4.5
Thailand	1962	6-8	[1] .2	4.4
Brazil	1962	4-8	[1] 7.4	4.2
Greece	1961	5-7	24.0	3.7
Group II				
Iran	1959	3-6	NA	3.6
India	1961	NA	3.7	3.1
Poland	1960	3-4	NA	3.0
Argentina	1957	5-6	NA	2.8
Chile	1962	12-15	[1] 39.0	2.8
Japan	1962	5-6	[1] 42.0	2.8
Spain	1961	NA	1.8	2.7
Colombia	1962	6-9	[1] 7.8	2.6
Nigeria	1962	4-12	NA	2.6
UAR	1961	3-7	7.7	2.0
Pakistan	1962	5 1/2-6 1/2	[2] 1.8	1.8
Tunisia	1961	2-7	8.4	1.6

[1] 1961. [2] 1959.

Sources: FAO questionnaires to respective governments; annual reports of federal and state banks; and agricultural development agencies and cooperative credit societies.

Several study countries have substantially increased their use of institutional cred since 1953 (table 66). This has been particularly true of Japan, Venezuela, the Philippines and Greece, all of which have made considerable agricultural progress. In contrast

the volume of institutional credit increased very little during the period 1953-61 in Thailand, India, Spain, Brazil, Mexico, and Colombia. Mexico and Brazil, however, have exhibited fairly rapid rates of increase in agricultural output; this again suggests the large heterogeneity of the study countries and the possibility that other factors may compensate for the disadvantages of individual countries.

Farmers in the study countries need more capital rather than merely more credit. Banking and credit institutions can influence supplies of capital available to the agricultural sectors through their effectiveness in mobilizing savings; through the effect of their interest rates and credit policies upon rates of savings; and through their influence upon the allocation of capital between agricultural and nonagricultural sectors. At the present time, the critical problem in most of the study countries is the inadequacy of their incomes to enable rapid accumulation of large amounts of capital.

Improvements in agricultural credit systems are needed in most underdeveloped countries. Yet, building large new credit institutions is not a panacea for increasing the supplies of capital to the levels needed for increasing agricultural output and productivity. Rather, in countries where governments assume a major role in the agricultural credit field, improvements in agricultural credit institutions will often need to be accompanied by taxation and by monetary and foreign trade policies that will help to increase the national rate of savings. Such savings are crucial to the effective use of credit to channel capital in ever-increasing amounts into agriculture. Large expansion of credit without an adequate base of savings can do little more than add to inflation, a fiscal problem that has plagued several less-developed countries in recent years.

Table 66.--Amount of institutional credit per ton of agricultural output measured in wheat equivalents, specified countries, selected years

Country[1]	Institutional credit in--				
	1953	1955	1957	1959	1961
Group I	----------	----------	U.S. dollars	----------	----------
Israel	--	33.8	42.4	41.8	42.2
Sudan	--	--	--	3.4	3.2
Mexico	16.6	12.7	13.8	17.6	21.5
Philippines	13.6	14.1	17.6	30.7	34.7
Turkey	15.4	19.2	22.8	--	7.7
Venezuela	20.7	5.9	5.7	32.0	22.2
Thailand	0.4	0.2	0.3	0.2	--
Brazil	4.7	4.8	5.8	5.1	7.4
Greece	--	16.0	21.9	22.9	24.0
Group II					
India	1.4	1.5	2.9	3.4	3.7
Chile	14.5	9.8	16.0	19.7	39.0
Japan	--	15.8	21.7	27.2	42.0
Spain	--	1.7	1.4	1.3	1.8
Colombia	8.1	10.5	6.4	7.8	7.8
UAR	4.6	2.7	3.7	5.1	7.7
Pakistan	1.7	1.5	1.9	1.8	--
Tunisia	6.1	12.6	--	--	8.4

[1] Countries are arranged by rate of increase in crop output.

Source: FAO data on agricultural production as expressed in wheat equivalent units.

CHAPTER 8.--DEMAND AND PRICES

Empirical studies on agricultural output and productivity generally determine the sources of increase in these factors and abstract from demand considerations (Durost and Barton, 12; Loomis and Barton, 36; and Strand and Heady, 60). But in terms of policies to increase agricultural output and to improve agricultural productivity, it is extremely helpful to view the development problem from the viewpoint of demand.

This chapter deals with the relationships between output and productivity and domestic demand, prices, exports, and imports. Emphasis will be on the important relationship between the commercial component of demand, as part and parcel of economic integration, and economic development of farm sectors in countries in their early stages of development.

Some Methodological Considerations

Because of the sample characteristics of the countries selected for study, the relationships indicated in this chapter are highly conditional. Many of the hypotheses which are considered here are clearly subsets of more general hypotheses which might have been investigated had there been much greater income differences among the countries. Conclusions drawn in this limited context should not be extrapolated to more advanced economies where other factors may relate more importantly to their stages of development.

Use of highly aggregate data--some of which are crude indicators for ideal measures--together with lack of full comparability dictate an ordinal or ranking scale rather than precise measurement of inter-country differences.[10]

The basic data for this chapter are presented in table 67, which shows the levels of the variables as of 1960, and in table 68, which shows the 1960 values as a percent of their 1950 values. However, the measurements for supposedly the same items in the two tables are not fully comparable by definition. Agricultural output in table 67 includes contributions from fisheries and forestry as well as those from crops and livestock products. In table 68 change in crop output is used as the indicator for change in agricultural output. The summary statistics indicating the associations among the variables are given in tables 69 and 70.

Agricultural Output

Agricultural Output and Domestic Demand

Domestic per capita agricultural output together with the net agricultural trade balance make up the available domestic per capita supply of agricultural products. Countries with high levels of per capita income (GNP) generally have high levels of agricultural output (fig. 10). The significant deviations from the sample trend of course derive from the fact that output and supply are not synonomous. Sudan, with an unusually high proportion of resources in agriculture, lies above the trend. Israel, Venezuela, Chile, and Japan are not self-sufficient in agricultural products, and must import to meet their domestic requirements (table 67, columns 5 and 6).[11]

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[10] Accepting an ordinal interpretation of our data has its disadvantages. It restricts us to rank correlation methods; thereby, we more frequently encounter specification errors.

[11] Significant deviations from the trend may result not only from differences in the quantity of resources committed to agricultural production, but also from differences in the levels of productivity. But the levels of agricultural productivity among the countries for approximately the same levels of per capita income are assumed to be similar.

Table 67.--Agricultural output and selected data, 22 countries, 1960

Country	Agricultural output	Total population	Per capita gross domestic product, 1958	Rural population as a percentage of total population	Agricultural exports (Av. 1959-61)	Agricultural imports (Av. 1959-61)
	(1)	(2)	(3)	(4)	(5)	(6)
	Million U.S. dollars	Thousands	Million U.S. dollars	Percent	Million U.S. dollars	Million U.S. dollars
ndia	14,659.6	431,698	70	[3] 81.9	602.7	524.9
apan	5,765.3	93,200	337	36.5	369.8	1,743.5
oland	4,029.2	29,703	[1] 538	51.9	[4] 202.7	[4] 389.9
akistan	3,383.0	96,558	64	[3] 87.2	[4] 262.1	[4 6] 119.0
urkey	3,177.9	27,829	254	68.1	306.9	68.3
pain	3,148.4	30,431	372	73.1	364.1	248.6
razil	3,107.2	70,967	145	[3] 54.9	1,102.9	206.5
rgentina	2,334.8	20,006	465	--	970.6	74.3
exico	2,197.7	34,988	321	49.3	[4] 493.6	[4] 75.9
AR	1,606.3	25,948	155	62.3	395.3	187.9
olombia	1,351.2	14,132	248	--	361.1	61.2
ugoslavia	1,174.1	18,402	[2] 179	--	193.6	209.2
hailand	1,064.5	26,258	84	88.2	349.7	50.1
hilippines	975.9	27,792	113	--	[5] 334.7	[4] 112.6
udan	897.8	11,770	66	--	[4] 175.2	[4] 58.5
reece	758.8	8,327	297	[3] 57.4	173.3	113.0
aiwan	420.0	10,612	97	--	120.8	65.0
enezuela	375.7	7,365	650	32.5	32.9	196.9
hile	353.3	7,340	405	32.8	[4] 14.5	[4] 68.5
anganyika	352.6	9,239	57	--	114.1	8.7
srael	222.7	2,114	905	15.2	75.6	115.5
osta Rica	96.0	1,171	251	[3] 65.3	79.4	18.4

Country	Agricultural exports as a percentage of agricultural output	Gross domestic product of agricultural origin, 1960	Arable land	Agricultural output per hectare	Agricultural workers	Agricultural output per agricultural worker	Agricultural workers per hectare	Agricultural wholesale price variability[14]
	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Percent	Percent	Million hectares	Dollars	Thousands	Dollars	Number	Percent
dia	4.1	[7] 49	161	91	128,214	114	0.80	18.8
pan	6.4	15	6	961	14,346	402	2.39	7.7
land	5.0	[7] 26	16	252	[6] 6,541	616	0.41	--
kistan	7.7	[7] 53	[8] 25.5	133	18,636	182	0.73	--
rkey	9.7	42	25	127	9,737	326	0.39	--
ain	11.6	27	21	150	4,803	656	0.23	--
azil	35.5	27	30	104	13,555	229	0.45	36.6
gentina	41.6	13	[9] 30	78	2,161	1,080	0.07	--
xico	22.5	19	[10] 20	110	5,948	369	0.30	4.9
R	24.6		[10] 2.5	643	4,403	365	1.76	--
lombia	26.7	35	5	270	2,544	531	0.51	--
goslavia	16.5	26	8.3	141	4,693	250	0.57	6.2
ailand	32.9	37	10	106	11,334	94	1.13	--
ilippines	34.3	[7] 33	[10] 7	139	5,383	181	0.77	6.6
dan	19.5	57	[11] 7	128	--	--	--	--
eece	22.8	28	3.7	205	1,940	391	0.52	3.9
iwan	28.8	33	0.88	477	1,846	228	2.10	27.1
nezuela	8.8	9	[10] 2.5	150	751	500	0.30	6.4
ile	4.1	[7] 12	[12] 6	59	646	547	0.11	7.9
nganyika	32.4	59	9	39	--	--	--	--
rael	33.9	[7] 12	0.4	557	1,122	1,825	0.31	4.6
sta Rica	82.7	33	[13] 0.3	320	--	--	--	3.1

[1] Data from Worldmark Encyclopedia and converted to dollars at zloty - 4.16 cents.
[2] Federal Statistical Institute Yearbook, converted to dollars at 632 dinars per U.S. dollar.
[3] Obtained by linear interpolations. [4] From U.N. International Trade Statistics, 1962. [5] Central Bank of Philippines, atistical Bulletin, December 1963. [6] 1961 only. [7] Net domestic product. [8] 1958. [9] 1957. [10] 1961. [11] 1954. [12] 1956. 1955. [14] Estimated by the average deviations about the regression line with current agricultural wholesale prices and time as e dependent and independent variables, respectively.

Sources: Agricultural output, see Appendix table 80; total population, rural population, and agricultural workers, see Chapter 6; oss domestic product, UN Yearbook of National Accounts Statistics, 1963; export and import values, FAO Trade Yearbook, 1962; able land, FAO Production Yearbooks 1961, 1962, and 1963; and price variability, U.N. Statistical Yearbook, 1958 and 1962, and O Monthly Bulletin of Agricultural Economics and Statistics, Vol. 12, May 1963.

Table 68.--Changes in selected variables related to agricultural output, 26 study countries, 1950 to 1960 (1960 as a percentage of 1950)

Country	Crop output	Total population	Real per capita income	Ratio of rural to total population	Agricultural		Ratio of exports to--		Ratio of agricultural wholesale prices to--		Output per--		Worker per hectare	Field crop output per hectare
					Exports	Imports	Imports	Output	General wholesale price	World unit values	Worker	Harvested hectare		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Percent													
Israel	252	167	128	86	2,259	1,005	225	896	117	426	133	153	115	2,228
Sudan	216	140	108	--	176	211	83	81	--	--	--	--	--	154
Mexico	184	136	121	86	244	96	254	133	108	226	--	--	--	136
Costa Rica	172	126	144	98	122	208	59	71	112	132	--	--	--	--
Philippines	166	137	118	--	139	156	89	84	95	118	--	113	93	102
Tanganyika	166	120	112	--	531	285	186	320	--	--	--	--	--	114
Yugoslavia	164	112	235	--	330	165	200	201	--	--	--	--	--	151
Turkey	155	133	137	87	124	195	64	80	--	--	--	--	--	103
Venezuela	155	148	142	--	112	524	21	72	--	--	--	--	--	--
Taiwan	155	140	144	--	119	190	63	77	120	437	150	138	94	136
Thailand	154	137	127	98	216	509	42	140	--	--	--	--	--	124
Brazil	151	136	130	86	96	85	113	64	93	678	110	--	--	105
Greece	144	110	158	90	189	196	96	131	--	--	148	143	96	134
Iran	142	124	--	--	372	283	131	262	103	188	--	--	--	121
India	136	122	118	99	160	127	126	118	--	--	--	--	--	117
Poland	134	120	179	63	--	--	--	--	--	--	--	--	--	134
Japan	132	113	208	58	277	153	181	210	125	199	176	122	69	130
Argentina	132	118	99	--	195	953	20	148	--	--	--	--	--	113
Chile	132	128	109	86	97	102	95	73	--	--	--	--	--	119
Spain	131	108	147	116	176	188	94	134	--	--	--	--	--	125
Colombia	129	124	126	--	104	124	84	81	--	--	101	--	--	--
Nigeria	129	144	121	--	164	322	51	127	--	--	--	--	--	--
UAR	122	127	128	91	117	120	97	96	--	--	--	113	--	116
Pakistan	120	124	103	97	89	564	16	74	--	--	--	--	--	105
Tunisia	117	120	118	--	199	198	101	170	--	--	--	--	--	60
Jordan	83	129	118	84	180	381	47	217	--	--	--	--	--	--

Sources: Percentage increases for crop output, total population, real per capita income, and crop output per hectare for 1960 obtained by extrapolation from the 1950 base by use of crop growth rates given in Chapter 1; population data, see Chapter 6; export and import values, FAO Trade Yearbook, 1962--Average 1959-61 values divided by average 1951-53 values, both deflated by the world average export unit values of agricultural products shown in Annex Table 16A, The State of Food and Agriculture, 1964, p. 234; agricultural wholesale prices, U.N. Statistical Yearbook, 1958 and 1962, and FAO, Monthly Bulletin of Agricultural Economics and Statistics, Vol. 12, May 1963.

The relationship between changes in per capita output and income shows much greater variation (fig. 11) than the relationship between the levels of per capita output and income (fig. 10). The greater variation in figure 11 may in part be explained by the differences in the initial consumption levels of the countries as reflected by the coefficients of income elasticity (table 2). Pakistan, Tunisia, Egypt, Nigeria, and Jordan failed to maintain output at rates equal to their population growth over the 1950-60 period. Also, Jordan had an absolute decrease in crop production, with the 1960 output only 83 percent of the 1950 output. But for a majority of the countries crop output exceeded population growth.

The two major determinants of domestic demand are per capita income and growth in population. Per capita income increased at faster rates than population in only 36 percent of the countries (table 68, columns 2 and 3). With the weighting of the increases in income by the countries' respective income elasticities, however, income was more important than population in only 19 percent of the countries--Yugoslavia, Greece, Poland, Japan, and Spain. Population growth was the more important factor for 81 percent of the sample countries (table 2, column 6).

Increases in demand and output over the 1950-60 period for 26 countries are shown in figure 12. In 12 countries, demand increased faster than output; in 9 countries, output exceeded demand; and in 5 countries, demand increased at approximately the same rate as output.

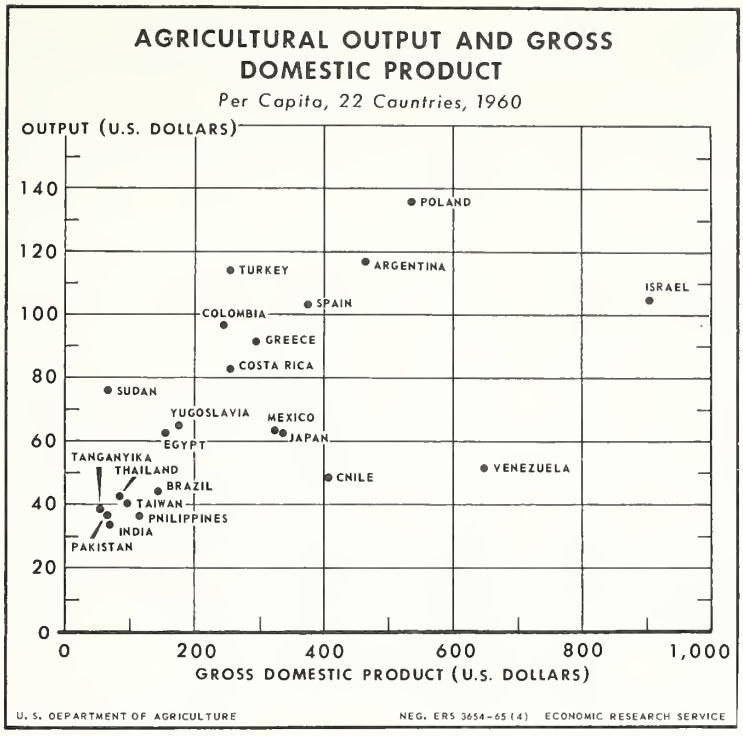

Figure 10

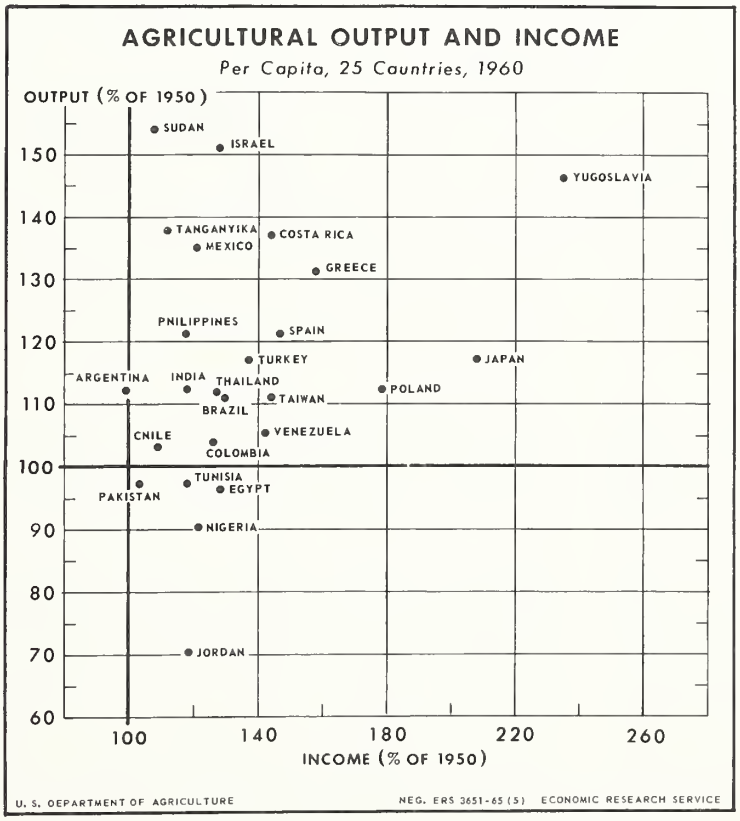

Figure 11

Figure 13 shows the relationship between the change in the output-domestic ratio and the export-import ratio.[12] Countries to the right of the line drawn perpendicular to the horizontal axis increased their output relative to domestic demand, and the countries above the line drawn perpendicular to the vertical axis increased exports relative to imports. For example, Jordan's output increased only 58 percent as fast as its domestic demand and its exports increased only 47 percent as fast as its imports, i.e., imports increased about twice as fast as exports.

Agricultural Output and Exports

As per capita agricultural output rises, opportunities for trade increase. Foreign trade is of critical importance in small countries that lack many diverse resource endowments.

The combination of a low value of per capita output and exports also deserves attention. In some cases, as in India and Pakistan, this happens because of the self-sufficient organization of their farm units. In other cases, as in Chile, Japan, and Venezuela, it occurs because the comparative advantage lies outside of agriculture.

Over the 1950-60 period, countries with large increases in output per capita generally had large increases in per capita exports as well (fig. 14 and table 70, row 3, column 2).[13] Countries that exported an increasing share of their output also had the smallest increase in prices relative to world prices (table 70, row 6, column 5). Countries with the largest increases in exports relative to output did not necessarily have the largest increases in productivity, as represented by the change in field crop yields (table 70, row 6, column 6).

Agricultural Output and Imports

Countries with large per capita output generally have large per capita imports (table 69, row 5, column 1). The fundamental relationship between imports and output, however, is not direct. Because of the enormous resources committed to agriculture in most of the sample countries, the relationship between agricultural output and imports follows directly the principles set forth by the theory of comparative advantage. As per capita income rises, the demand for both quantity and variety of products also rises (table 69, row 5, column 1). Since all inputs are less than perfect substitutes for each other in all production processes, trade has a distinct advantage over completely balanced production in meeting domestic consumption.[14] Since most of the countries depend upon agriculture for a large share of their total export earnings, agricultural exports are related to agricultural imports via the foreign exchange account.[15] As a nation grows economically, sectors other than agriculture increase in relative importance; thereby, dependence of agricultural imports on agricultural exports is reduced. This has been the case in Japan.

It should be clear that the relationships among imports, output, exports, and income described above are only directional and do not extend to size of increases. The consumption levels of the countries and their ability to produce at competitive prices dictate the magnitude of change in imports associated with an increase in income. It is not surprising, then, that although over the 1950-60 period, 21 of the 26 countries increased

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[12] The rank correlation coefficient for the ratio of change in output to demand and the ratio of change in exports to imports is .18, with a significance level of .104. A linear relationship between the ratios should not be expected because of the disproportionate magnitude of output relative to exports and imports. The great departure of Sudan from the sample trend is probably due to the upward bias of the output index.

[13] The correlation of the percentage change in exports to the change in the agricultural wholesale price-world unit price ratio (table 70, row 2, column 5) yielded the expected negative correlation coefficient (-.33), but the level of significance was only .13. Part of the low significance level no doubt is due to our failure to adjust the price ratios for changes in the pegged exchange rates.

[14] The rank correlation coefficient between per capita income and per capita imports is significant at less than the .0003 level; per capita income is significantly associated with per capita exports only at the .291 level. Per capita income and per capita exports then appear to be unrelated.

[15] The rank correlation coefficient for per capita exports and imports is .33, with a significance level of .013.

Table 69.--Rank correlation coefficients for selected items, 1960[1]

Item	Output per capita	Per capita GDP	Output per worker	Output per hectare
	(1)	(2)	(3)	(4)
?er capita GDP.....(1)..	.51 [2] (.00023)		.77 [2] (.00003)	.20 (.097)
?opulation.....(2)..			-.271 (.045)	-.16 (.149)
?ercent rural population....(3)..	-.24 (.111)		-.58 (.0013)	-.20 (.149)
?er capita exports.....(4)..	.37 (.006)	.08 (.291)	.29 (.034)	.14 (.176)
?er capita imports.....(5)..	.33 (.012)	.50 [2] (.0003)	.46 (.0021)	.51 [2] (.0003)
utput per worker.....(6)..				.21 (.111)
orker per hectare.....(7)..		-.51 (.0012)	-.53 (.0008)	.27 (.053)
rice variability.....(8)..		-.27 (.109)	-.27 (.121)	-.27 (.192)

[1] The significance level of around 10 percent is used in rejecting the null hyphotheses f zero correlation. The unenclosed values are Kendall's Rank Correlation Coefficients; he enclosed values are their respective probabilities of being observed under the null ypothesis of zero correlation. For example, the probability of observing a rank correlaion of .77 between output per worker and per capita GDP if in fact they were uncorrelated s less than .0003 percent.

[2] Less than the indicated values.

Source: Table 67 and Appendix tables 80 and 81.

oth their per capita output and imports (table 68, columns 1, 2, and 6), the variation etween their percentage increases was too great to indicate any identifiable pattern for he sample as a whole (table 70, row 5, column 2).[16]

Though price data are limited, the correlation results do indicate some difference n the degree of effectiveness of prices as directives of trade flows. As discussed above, he export-output ratio was sensitive to changes in the domestic price relative to the world rice. This sensitivity is not seen in the import-output ratio when correlated to the relave changes between domestic price and world price (table 70, row 7, column 5). These elationships suggest that exports were generally permitted to be influenced by changes the external-internal price relationships, but that imports were not so influenced. This consistent with historical experience which clearly shows that though trade policies

[16] In the above correlation of their absolute levels, the relationship between imports and income and exports produced a sigr cant association between imports and output. The association between them and their common related variables was sufficiently s ong to maintain the transitive relationship to imports and output. In relating percentage changes between the variables, however, this t nsitivity is broken as changes in per capita income are not significantly correlated to changes in per capita imports, even though t correlation between changes in per capita exports and imports was significant (table 70, row 5, column 4).

Table 70.--Rank correlation coefficients for changes in selected items, 1950-1960[1]

Item	Output	Output per capita	Exports	Exports per capita	Agr. wholesale and world unit price ratio	Field crop yields	Per capita GNP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Population total.....(1)..	.27 (.027)					.08 (.312)	
Exports.....(2)..					[2] -.33 (.130)	.30 (.031)	
Per capita exports.....(3)..		.42 (.0018)				.29 (.036)	.12 (.203)
Imports.....(4)..	.02 (.444)		.25 (.038)		[2] -.28 (.179)		
Per capita imports.....(5)..		.04 (.378)		.28 (.025)			.11 (.224)
Export-output ratio.....(6)..					-.50 (.038)	.17 (.147)	
Import-output ratio.....(7)..					-.33 (.306)		
Per capita GNP.....(8)..		.19 (.095)				.28 (.043)	
Price variability.....(9)..		-.58 (.0031)				-.42 (.035)	
Agricultural wholesale Price, general..... Wholesale price ratio...(10)..		.42 (.072)				.47 (.068)	

[1] Same as in table 69. [2] Same for per capita exports and imports.

Source: Table 68 and Appendix tables 80 and 81.

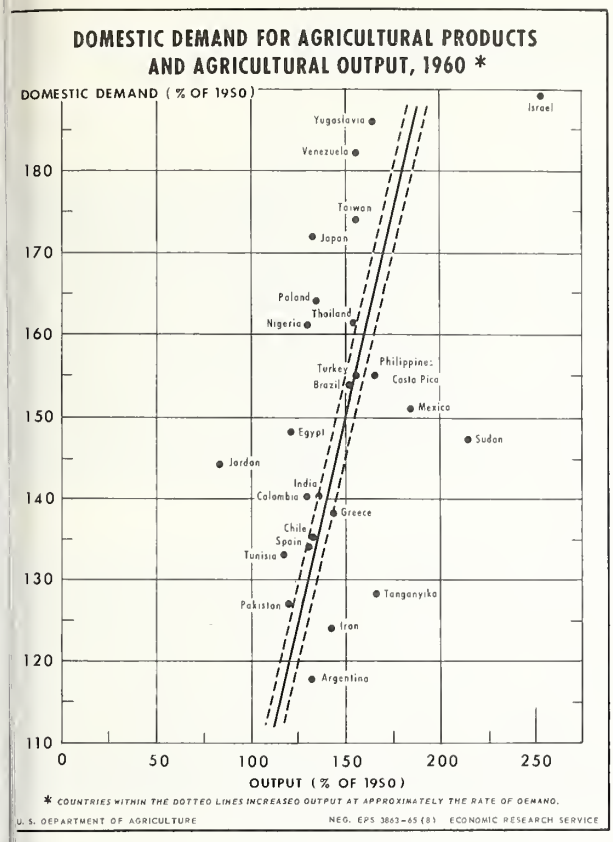

Figure 12

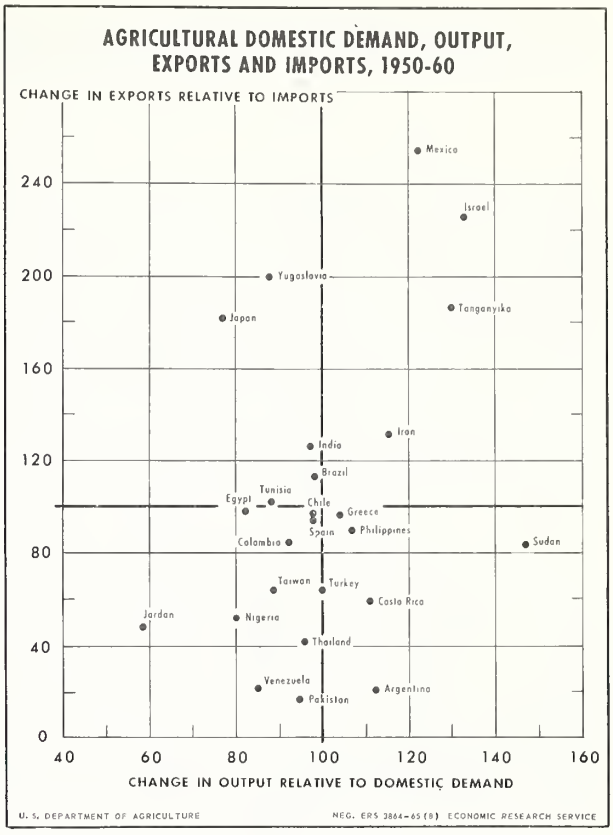

Figure 13

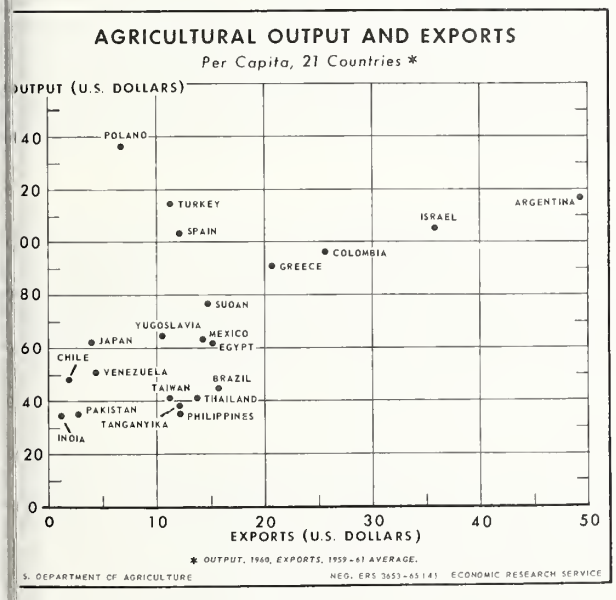

Figure 14

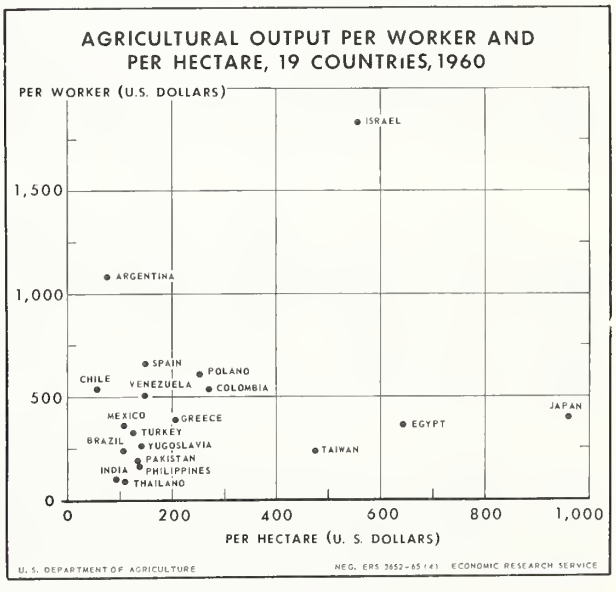

Figure 15

may insulate the economy from "undesirable" external influences, prices are the mos important and consistent guide for an individual country's exports.[17]

Productivity

Demand variables important in influencing output are also the important variable influencing levels and changes in productivity. Interpretation of the relationships differs however, because of the close association between productivity and general economi development. As economic development progresses, an economy becomes more com mercialized and integrated. Fuller integration results in enlargement of the effectiv market for individual producers and regions; an increased flow of goods and service through a national currency medium and improved communications, which helps to reduc costs, risk and uncertainty, and improve real income expectations; spread of knowledg of production techniques; and more profitable exploitation of the agricultural input markets In the course of time, the greater efficiency of all agents of the economic system generate an interdependence among the economic units; in turn, this interdependence enhance cumulative improvements in productivity even further.

As mentioned earlier, demand is a product of population and per capita income. Bu demand increases associated with population growth are not necessarily associated wit market demand, whereas growth in per capita income is usually related to commercia demand. Should per capita income be stagnant over time, increases in population wil likely be distributed proportionately according to some recent historical trend, with n relative increase in market or commercial demand. Conversely, as per capita incom increases, population, production, and consumption usually shift increasingly to non agricultural sectors; the effect is an increasing nonfarm demand for agricultura products. The changes in the relationship between population and commercial demanc then, hinge on the presence of increases in per capita income.[18]

This interpretation of the relationships of per capita income, population, and com mercial demand is, of course, restricted to countries in their early stages of development Even present day Japan and Israel, among others, may be sufficiently integrated eco nomically that increases in the ratio of market demand to total demand for agricultura products are limited by their proximity to their saturation point for commercialization In addition, the gross correlation between productivity and per capita income is not solel a function of demand factors since per capita income is correlated with all sorts of change associated with general economic development. On the demand side, however, the ke element accompanying economic development is the increase in commercial demand a part and parcel of economic integration.

Productivity is a measure of the efficiency with which inputs are converted into good and services. Dividing total output by total inputs gives average output per unit of input Admittedly, all productivity measures are partial in some degree since in practic measures of output and input are never all-inclusive. Because of data limitations, th partial productivity measures of output per hectare and output per worker are used t represent the level of productivity, and change in field crop yields is used to represer change in productivity.

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17 Evidence suggests a very strong interdependence between the relationship of imports and prices to exports and prices. A indicated in footnote 14, the correlation of the percentage change in exports to the domestic-world price ratio, though it yields negative coefficient, is significant only at the .13 level. We attributed this low significance level to our failure to adjust for changes exchange rates and to the combination of countries with diverse supply patterns. No significant homogeneity can be expected. The co relation between imports and the price ratio is similarly negative; and it also lacks any direct negative relationship between the pri ratio and imports since it contradicts the axiom that supply should be from the cheapest source, i.e., we do not increase imports wi world prices rising relative to the domestic price. Rather than this simple relationship between imports and the price ratio, howeve what we really have in the negative correlation between imports and the price ratio is a reflection of the correlation between impor and exports, and between exports and the price ratio. Although the world price may be rising relative to the domestic price, a count may still import because the terms of exchange may dictate greater value of imports for each unit exported.

18 For the sample countries, the rank correlation coefficient for population and per capita income is significant at the 12 pe cent level; for changes in the variates, the significance level is 22 percent.

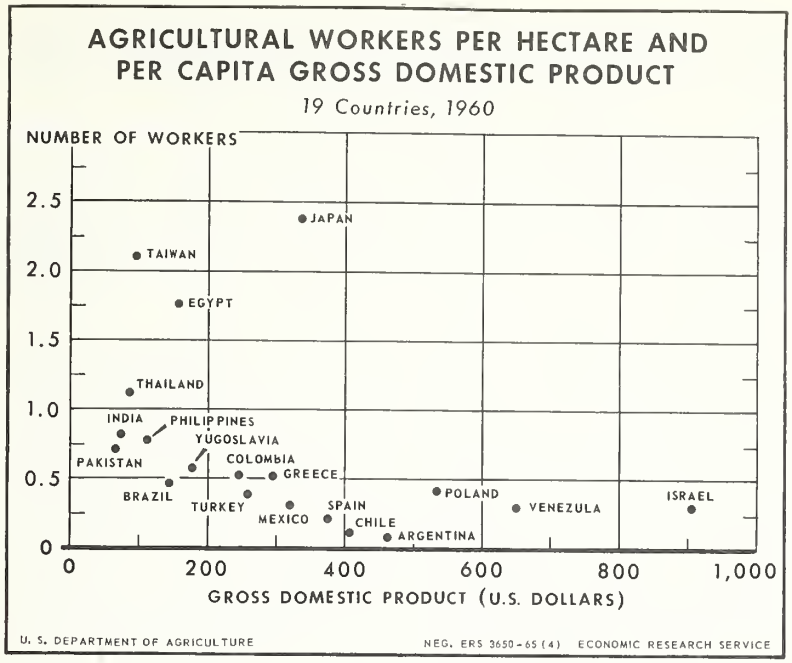

Figure 16

As a country develops economically, both output per worker and output per unit of land area rise (figs. 17 and 18). Though the effectiveness of land and labor tends to increase jointly, the relationship between these two indices is not perfect, a fact which again reflects differences in resources among countries (fig. 15 and table 69, row 7, column 3).[19] Since the land and labor indices are not perfectly correlated, which ratio is the most meaningful? Preference should be given to labor productivity since the ultimate goal of all economic activity is human consumption, and since, in the context of economic development, it is the surplus over the rural population needs that is most crucial. In addition, the number of workers employed per hectare decreases with increasing per capita income over an extended range; this means that even though yield per hectare and output per worker increase together, there is a stronger relationship between labor productivity and development than between development and land productivity. The relationship between worker per hectare and per capita income is shown in figure 16 and in table 69 (row 7, column 2). Data indicate the high population-land ratios of Japan, Taiwan, and Egypt.

roductivity and Demand Associated with Population

Since the relationship between growth in commercial demand and population in developing countries depends mainly on the behavior of per capita income, one would not expect levels of either of the partial productivity ratios to be correlated with population size; this is consistent with our hypothesis concerning the nature of demand and population. Table 69 (row 2, columns 3 and 4), however, shows that while population and output per hectare are not correlated, population is negatively correlated with output per worker; this result is not consistent with our demand hypothesis because it implies that demand from large populations is associated with low output per worker. This clearly is the case where the correlation reflects the supply relationships rather than those specified by the demand hypothesis. In most of the study countries, a large proportion of the population made up both the labor in agriculture as well as the consumers for the products. It follows that the statistical relationship between population and output per worker actually refers to the positive relationship between population density and worker density, and to the

[19] The rank correlation coefficient for output per worker and output per hectare is .21, with a significance level of .111. This relationship is statistically significant because of the "definitely" known errors in the variable "hectares under cultivation". As shown in footnotes to table 69, not all values refer to the same point in time, but all adjusted output refers to 1960. Some countries report area planted and if the area is sown twice, it is counted twice, whereas cultivated hectares are defined as farm land under cultivation and are counted once regardless of multiple cropping.

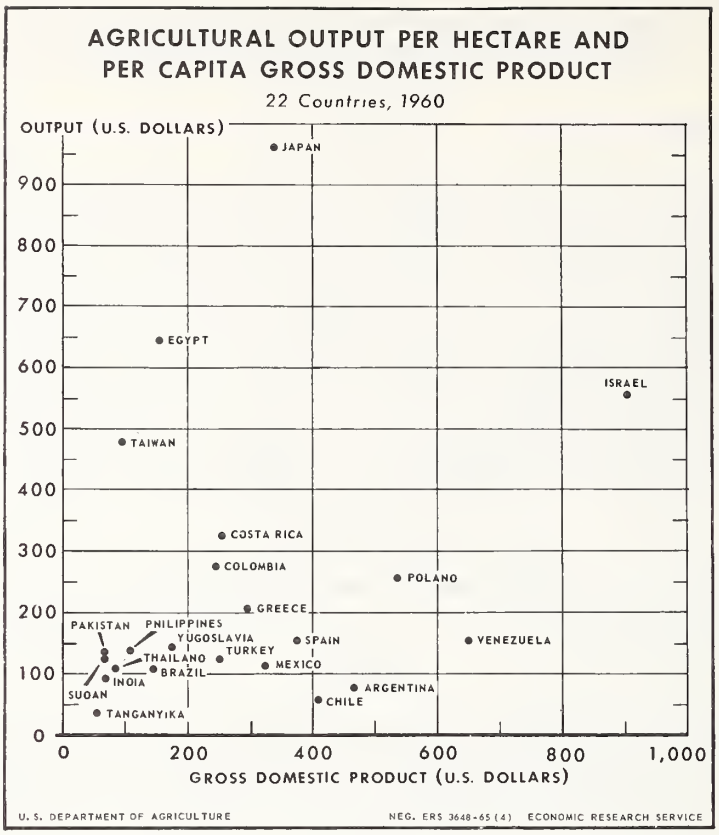

Figure 17

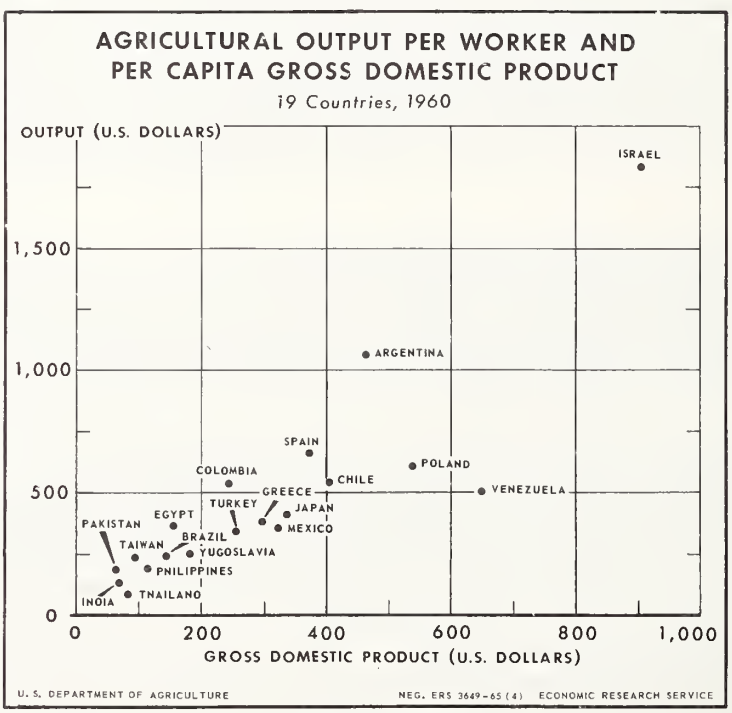

Figure 18

negative relationship between worker density and output per worker. Countries with a large number of workers per hectare tend to have low output per worker (table 69, row 7, column 3).

Over the 1950-60 period, countries with large increases in population were not necessarily those with large improvements in productivity (table 70, row 1, column 6). When population increases and productivity remain static, the increased population must devote its energies to the more basic task of feeding itself. More importantly, where land is limited, the output increment tends to decrease--though not necessarily proportionally--with succeeding increments of labor.

Productivity and Commercial Domestic Demand

Countries with high income levels and resulting high levels of domestic commercial demand have high levels of productivity (figs. 17 and 18, and table 69, row 1, columns 3 and 4). But the association is closer in the case of output per worker than in the case of output per hectare. Why this difference? Two explanations are possible: (1) Over an extended period of economic development, labor is combined progressively with many capital inputs and improved technologies, such as various hand and mechanical implements; these inputs tend to complement labor more than land (fig. 16). Yield-increasing inputs, however, affect both land and labor in a more or less uniform manner. Labor-saving inputs, which are applied increasingly in the course of development, increase output per worker more than per hectare.[20] (2) The second explanation follows from the relationship between agricultural output and national income. In a majority of the study countries, increases in agricultural output per worker result in increases in per capita income. Increases in output per hectare may or may not be associated with increases in per capita income, depending on the relationships between national income and agricultural output and between population and agricultural workers as yields increase.[21]

Figure 19 shows the relationship between changes in field crop yields and in per capita income during 1950-60 (also see table 70, row 8, column 6). Countries with a large percentage increase in domestic commercial demand generally had a large percentage increase in productivity.

Productivity and Exports[22]

Countries with large exports per capita generally had high output per worker but not necessarily high yield per hectare (table 69, row 4, columns 3 and 4). Countries with high yield per hectare tend to be densely populated and to have large numbers of workers per unit land area (table 69, row 7, column 4). High output per worker--resulting from a favorable land-worker resource base, a high level of capital substitution for labor, a high level of farm technology, or a combination of all three--does not tend to be associated with densely populated countries. As a result, domestic production is more than sufficient to meet domestic requirements, and large per capita exports are possible.[23]

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20 The absolute decrease in farm labor which is occuring in Japan, Poland, and possibly Israel will reinforce the tendency for labor to be applied less intensively than land with economic development. The majority of the sample countries have not yet reached this stage of development.

21 We use output per worker and output per hectare as substitute measures for productivity, and per capita income as a substitute or carrier for commercial demand. The closeness of the proxy variables to the variables they represent obviously differs. Output per worker in predominantly agrarian societies is a large component of per capita income, and hence, they have a close linear relationship. Output per hectare, an indirect component of per capita income, does not necessarily show such a close relationship.

22 No direct relationship exists for imports and productivity. To establish any kind of relationship, we must relate them to their jointly associated variables--supply, demand, and prices.

23 Countries such as Japan, Taiwan, and Egypt, 3 of the 4 countries with the highest yield per unit area and with relatively low output per capita, are typically heavily populated countries that apply large amounts of labor relative to land. This results in a relatively high yield per hectare, low worker output and low output per capita--all adding up to a strong domestic demand relative to domestic output. Countries with exceptionally large exports per capita relative to output per hectare show a similar deviation from the sample trend--but in the opposite direction. These countries produce greatly in excess of their domestic needs. High worker-hectare ratios, low output-worker ratios, low output per capita, and low per capita exports generally occur together.

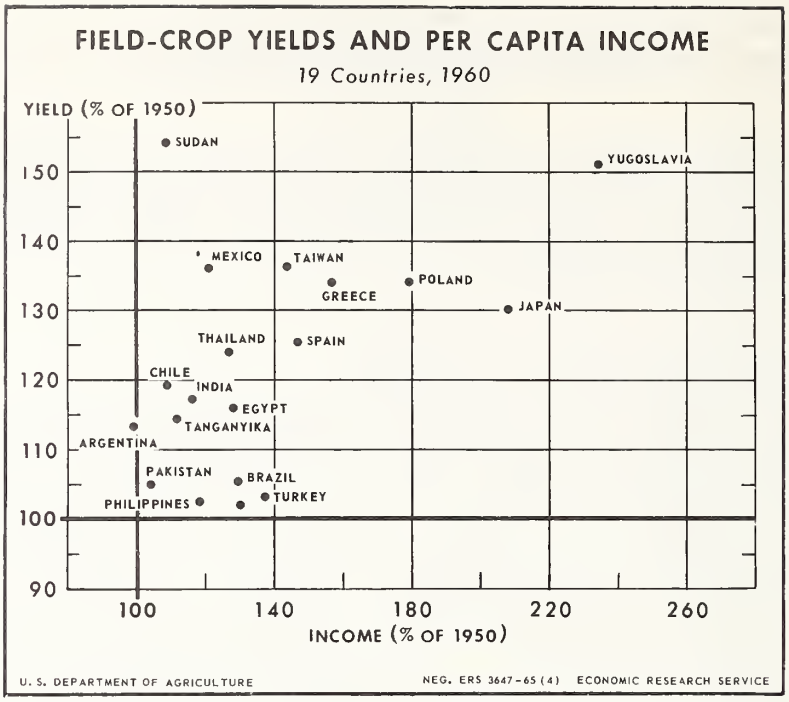

Figure 19

In the 1950-60 period, countries with large percentage increases in exports, per capita or aggregate, generally had large percentage increases in productivity (table 70, rows 4 and 5, column 6). Judging from the degree of correlation between productivity and domestic commercial demand, and between productivity and exports, there is no identifiable pattern over the 10-year period for increases in productivity in either domestic or foreign markets.

Prices

Since comparable measures of the absolute level of prices across countries are not readily available, the relationship between output levels and absolute price differences among countries will not be investigated here. Product prices, however, are but one of three dimensions that affect the farmer's profit margins. Input prices and technical input-output ratios are equally important. For example, the gross relationship between the change in real agricultural prices and the change in domestic output relative to domestic demand indicates large variations among the countries. By themselves, changes in product prices are not sufficient "to explain" the change in domestic output relative to domestic demand. But inclusion of one additional factor (fig. 20) suggests that countries with the larger increases in output relative to domestic demand generally had larger productivity increases relative to their product price.[24] Without offsetting movements in factor costs, producers in these countries obviously must have been better off. Clearly, product prices must be considered together with all other factors that affect the real income position of the farm sector.

Turning to price variability, for given levels of prices the larger the price fluctuation the larger the depressing effect on output and productivity. The relationship between price fluctuations and output and productivity is not asymmetrical, however. Output and productivity have a bearing on economic growth, and in turn the level of economic development influences the magnitude of price fluctuations. As countries ascend the development

[24] The positive rank correlation coefficient for the ratio of changes in productivity relative to prices and the ratio of changes in output relative to domestic demand is significant at the .0054 level.

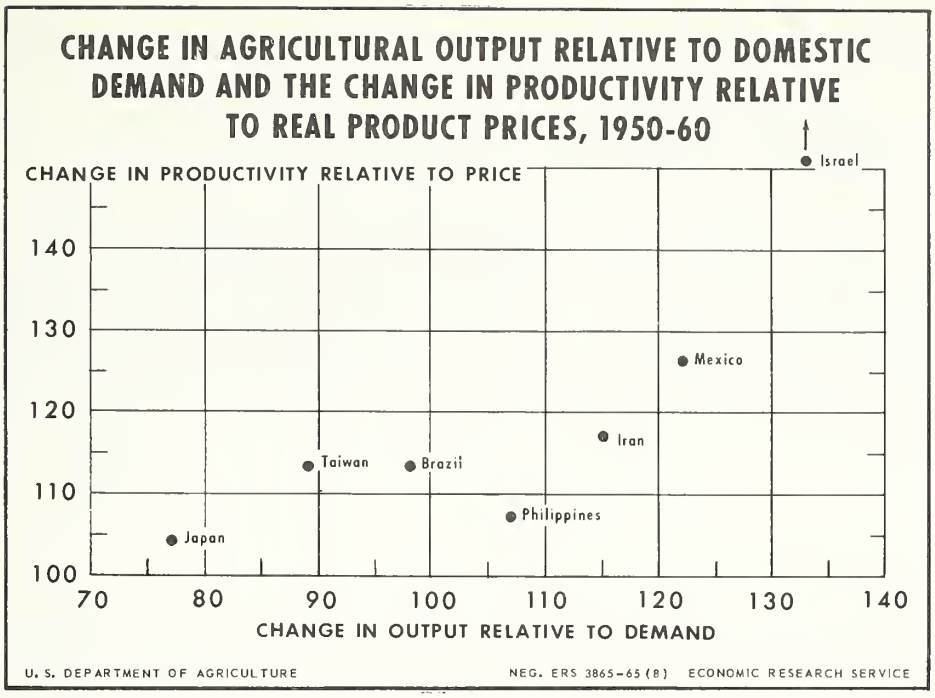

Figure 20

ladder, there is a more even distribution of marketing in time, space, and form as storage, transportation, communications, and processing facilities improve; as a result extreme price variations even out. Risk and uncertainty diminish with this decrease in price fluctuations. This fosters improvements in productivity through encouraging (1) a more efficient allocation of resources as the premium for hedging or flexibility against price fluctuations decreases, and (2) a more rapid rate of adopting improved production techniques and inputs, since more planned expectations materialize and the cost of failure to meet past and anticipated purchases for everyday needs and production requisites diminishes (Johnson, 29, and Stigler, 59). It is not surprising, then, that at their respective price levels the study countries with large price variabilities generally had smaller percentage increases in per capita output and productivity (table 7, row 10, columns 2 and 7). The results, however, do not indicate any association between level of productivity and price variability (table 69, row 8, columns 3 and 4). This lack of association may have resulted from use of the variance dimension rather than the absolute levels of prices.

Little can be done to directly manipulate either the per capita demand for food and fiber products in the urban centers or the aggregate demand in the importing countries. The fact that current consumption levels are less than desirable suggests a substantial potential demand, but it is not clear how this potentiality can be translated into effective demand without first increasing incomes.

Furthermore, if increasing per capita income is the main target of economic development, then agricultural output and productivity--despite their interrelationship--should best be thought of as contributors to increasing income rather than vice versa. Also, of themselves product prices have limitations as a policy instrument for increasing demand. High guaranteed stable prices may be largely an income supplement without producing the desired effect on either agricultural output or productivity.

If a nation cannot directly manipulate the customary demand variables, how can the demand side be used to promote increases in agricultural output and productivity? In this chapter, it has been shown that improvements in productivity are related to increasing

commercialization of the farm sector in the study countries. Accelerating the process of commercialization may therefore be an important indirect approach to manipulating demand variables. Past and present programs for agricultural development have largely emphasized performance within the farm, and have neglected roads and other features linking farmers to the rest of the economy (Collins and Holton, 10). Yet, the relation of the commercialization of agriculture to increasing productivity suggests a need to use product assemblers, distributors, processors, and the agricultural-nonagricultural connecting infrastructure, such as roads and communications, and input suppliers, as more active vehicles for organizing the rural sector for accelerated development. Breaking down internal trade barriers and market imperfections would be part of such an approach. The deliberate creation of more active and positive links between the rural sector and the rest of the economy would bring about fuller integration of the rural economy with its urban-industrial complex and spur progress in the agricultural sector. This emphasis would also facilitate fuller utilization of scarce entrepreneurial abilities, which tend to be more heavily concentrated in urban than in rural areas.

CHAPTER 9.--MARKETING FACILITIES AND PRACTICES

Market Systems and Economic Development

The future of agriculture in less-developed countries will depend heavily on available markets for its products and adequate facilities and practices for moving them to the consumer. Already, at least 50 percent of the world's population lives in urban areas away from farms and must rely on markets for food and clothing. Even subsistence farmers use some clothing and food items supplied by the market system. Indeed, economic development is often characterized as a movement away from subsistence and barter to an increasingly sophisticated and complex market system. Therefore, the rapid growth and improvement of farm product market facilities and operations are vital to the development of less-developed countries.

Development will increase the demand for farm product market services in at least four ways. First, population at present growth rates will likely increase 50 percent over the present world population within the next two decades. This will require at least comparable growth in market facilities and operations. Second, with economic development, an increasing proportion of the total population will live away from farms and rely on markets for food and clothing needs (table 71). This will require growth of market systems over and above the rate of population growth. Third, people will consume more and better food and clothing as their real incomes improve; thus demand for market services will grow even larger. Also, as fresh fruits and vegetables and livestock products make up an increasing proportion of their diets, these commodities will require greater care and more specialized facilities in handling, transportation, and storage. Fourth, increasing specialization generally accompanies economic development and increases the dependence of all upon the market system. Some operations performed by the farm producer will likely be transferred to the market sector and other services will be added to those already performed in marketing. These shifts will require more skillful organization and practices in the market system if producers are to receive the necessary economic incentives.

These four pressures for expansion of market facilities and operations aggregate to sizeable proportions. Data in table 72 illustrate--and probably understate--the market growth needs likely to result from the combined effects of various growth rates in population, per capita real income, and market dependence (shifting proportion of population from farm to nonfarm occupations), under assumed income elasticities for farm products.

With a 2-percent growth rate in each determinant (population, per capita income, and market dependence) and a .5 income elasticity, the annual market requirement growth is 5 percent (table 72). This is two and one-half times as large as the effects of growth of any one of the factors taken singly. They amount to a 63-percent increase in a decade.

While they are amazingly large, these estimates of market requirements for growth do not take account of the effects of (1) consequence of simultaneous growth in all of the conditions influencing needs for market facilities, (2) increased facilities and care required for shifts to perishables as income improves, (3) increasing specialization and additional services provided by market agencies as development occurs, and (4) factors that are implicitly more limiting in the data of the table than probably is true in the real world of a developing economy (see footnotes to table 72).

The extent to which market growth leads growth in the demand for marketing facilities and services will affect general development itself from which, in turn, demand for market services is derived. A lag in farm product market facilities and institutions can

Table 71.--Urban as a proportion of total population and increases in the urban-total ratio, specified countries, 1950-60

Country[1]	Urban as a proportion of total population in--		Increase of 1960 over 1950 ratio
	1950	1960	
	Percent		
Group I			
Israel	82.3	85.7	4.1
Mexico	42.6	50.9	19.5
Philippines	26.9	42.7	58.7
Taiwan	52.6	59.5	13.1
Turkey	21.9	37.8	72.6
Venezuela	53.8	67.6	25.7
Thailand	9.5	11.8	24.2
Brazil	36.2	45.1	24.6
Greece	36.1	45.2	16.9
Group II			
Iran	20.0	41.8	109.0
India	17.2	18.1	5.2
Poland	16.1	48.1	198.8
Argentina	64.0	67.0	4.7
Chile	61.7	67.1	8.8
Japan	37.5	63.1	68.3
UAR	32.0	37.5	17.2
Tunisia	32.1	38.2	19.0
Jordan	35.6	43.8	23.0

[1] Countries are arranged in descending order of their rate of change in agricultural crop output.

Source: Constructed from basic data in the United Nation's Demographic Yearbook. Adjustments to 1950 and 1960 were made for those countries with data in other years by application of the compound rate of change in total and in urban population between the years given.

severely curtail growth in agriculture and in the general economy. Such lags lessen the pressure for growth of the market system or help to make the present market system seem more adequate for present needs. Markets are therefore causal stimulators of production. Cultivators who do not have easy market outlets have little incentive to produce beyond their own needs. Lack of economic incentives is generally considered a major barrier to increasing agricultural output in many areas in the less-developed countries. The market place is the main focal point through which economic incentives to cultivators are expressed.

Markets for surplus crops can provide farmers with income needed to improve their nutritional levels, and in this way can improve the human agent as a productive factor.

Improving the market system serves two general development objectives: First, it lowers costs per unit of market services, a saving which may be passed on to consumers in lower prices for foods (increasing the quantity demanded), or back to producers as higher prices for their products (inducing an increase in the quantity supplied).[25] Second, it increases the efficiency with which consumers' wants and preferences in regard to quality and kind of products are reflected back to growers.

[25] Unique conditions may, of course, result in a backward-sloping supply curve.

Table 72.--Annual growth rates in agricultural product market requirements associated with assumed rates of growth in per capita income, market dependence, and population

Per capita income growth	Market dependence growth rate[1]	Growth rates in market requirements associated with specified population growth rates					
		1%	2%	3%	1%	2%	3%
		(1)	(2)	(3)	(4)	(5)	(6)
		(.5 income elasticity)			(.75 income elasticity)		
Percent	Percent	Percent					
2	1	3.0	4.0	5.0	3.5	4.5	5.5
	2	4.0	5.0	6.0	4.5	5.5	6.5
	4	6.0	7.0	8.0	6.5	7.5	8.5
4	1	4.0	5.0	6.0	5.0	6.0	7.0
	2	5.0	6.0	7.0	6.0	7.0	8.0
	4	7.0	8.0	9.0	8.0	9.0	10.0
6	1	5.0	6.0	7.0	6.5	7.5	8.5
	2	6.0	7.0	8.0	7.5	8.5	9.5
	4	8.0	9.0	10.0	9.5	10.5	11.5

[1] Defined as the increase in the proportion of the total domestic consumption of food and clothing that is obtained from markets rather than from subsistent production. The rate of growth in urbanization (the shift from rural to urban living, table 2) is indicative of the growth in market dependence, but may not be as reliable a measure as one would want. For example, the urban population is usually defined in terms of those living in towns in excess of 2,000 or 2,500 population or some similar figure. Many of those in towns or villages with less than 2,000 people also rely on the market for food and clothing; probably, these areas do not grow as rapidly as urban centers in early stages of development. Too, those people on farms may get some of their basic necessities from the market. However, in early stages of development it probably is a small percentage. Consequently, while the urbanization trend may be the most reliable empirical measure available of the growth in market dependence, it likely overstates it somewhat.

Conceptual Considerations

While the previous section dealt with the growth needs of market systems for agricultural products in developing countries, the following discussion will consider the problems associated with existing market facilities and practices in the study countries.

Wide marketing margins suggest that exorbitant charges and monopoly profits may characterize markets in less-developed countries. These characteristics however, can result from high costs of providing services under existing market conditions. Indeed, viewed in a static, nongrowing setting, markets in less-developed countries may be efficient in that they are providing services at competitive equilibrium rates. If they remain efficient in this sense, it is only because change does not occur. If growth occurs, then present market facilities and practices (which may themselves inhibit growth unless improved) are likely to become increasingly inadequate. On the other hand, marketing facilities in developing countries should be kept somewhat in line with patterns that are most economic considering their present resource balances and stage of development. These countries do not now, and will not for a long time, need many of the features which characterize the highly sophisticated marketing systems of economically advanced nations, especially those in the United States.

Large returns in greater efficiency, lower cost of operations, higher returns to cultivators, and lower prices to consumers may well be obtained in many areas of marketing by changes that add little to overall costs, but lower significantly the unit cost of services.

New Market Production

The general growth of farm product market operations involves initiating new markets as well as expanding old ones. Although both sources of market growth share many of the same problems, new market growth is sufficiently important to justify separate treatment here. The potential for increasing agricultural production by providing market facilities and outlets in areas where products are not grown for the market but are well adapted has often been noted. In some cases, the demand potential is known to exist; in others, it is yet questionable.

Development plans in the mid-1950's for the Papaloapan and Grijalva-Usumacinte River basins of Southeast Mexico showed that rubber, tea, vanilla, spices, and fibers were suited to the areas, even though they had not been previously grown there. The development plans in general were commendable, but the principal effort prior to 1957 in the Papaloapan Basin was toward increasing output of sugar and rice, both in surplus world supply. The initial plan for the basins included some facets which were not specifically directed to improving markets. One of these was road improvement; considerable agricultural development came about spontaneously along newly completed roads (Wylie, 71).

Planned inducement of sugar production to reduce imports has been successfully undertaken in many countries, notably Chile, Greece, Iran, and Sudan. Plans generally provided means of constructing and operating sugar mills, and market agreements or price commitments to growers.

Rapid increase of corn production and exports in Thailand has resulted from the opening of roads linking markets with producing areas (Work, 70). After construction of all-weather roads connecting the mountain province to market places in lowlands of the Philippines, farmers shifted from subsistence crops to cash, cold-weather vegetables that drew high prices in the markets (Abbott, 1, p. 9). Both production and market potentials had existed for many years, but lack of facilities had deferred their exploitation.

The Kulu Valley and Simla Hills of India are suitable areas for fruit production, but have not been developed due to lack of quick means of transport to consumers (Abbott, 1, p. 19). Grapes, melons, and many other fruits and vegetables could be produced in the Mediterranean region at a time when such produce is not available in central and west European countries, but this area presently lacks refrigeration facilities (Abbot, 1, p. 24).

These are only a few examples of areas where establishment of market facilities have initiated or might spark new market production, but they suggest important pointers for economic plans of less-developed countries. First, lack of market facilities can completely nullify the efforts to encourage production for market. Second, the provision of basic market needs, such as roads, means of transport, and communication, often results in spontaneous growth of new market production quite aside from, or in addition to, the anticipations of planners. Third, careful planning and provision of proper incentives can encourage direction of such new production toward the greatest demand potentials and away from market surpluses and depressed demand conditions. Fourth, and most importantly, careful evaluation of market potentials and the most effective means of directing production toward the most favorable markets would improve development plans.

Market Facilities

More adequate transport, storage, and processing facilities tend to lower the cost between farmers and consumers, so that a higher price can be paid to the producer

(inducing him to produce more) and a lower price charged the consumer (inducing him to consume more). In many cases, a substantial part of the increased efficiency may be reflected in quality improvements rather than in lower prices.

Transportation

It is reported that crops such as rice and maize are grown in place of more suitable market crops such as manilla hemp in parts of the Philippines because of transport difficulties (FAO, 17). Market conditions for livestock products in Greece are complicated by poor communication and excessive transport charges (FAO, 18). Estimates of cost of operating trucks in Turkey vary from 35 cents per kilometer on unimproved roads to 22 cents on better roads. The average annual truck cost on the rough roads of Latin America and Africa ranges from $2,000 to as high as $10,000 for refrigerated units. The fitting of bullock cart with axles and pneumatic tires from trucks doubles the load a given tractive power can pull and lessens wear on soft country roads (Abbott, 1).

Past experience, as well as the above examples, support the view that improving transport facilities stimulates increases in agricultural output. Mexico's market sales of fresh fruits and vegetables expanded rapidly in the last decade as highways improved, and permitted rapid truck transport to the larger markets in the country (67). A road linking La Paz, Boliva, to a nearby area in 1938 resulted in spontaneous and intensive growth of farm products to fill market needs. Feeder roads built after the war in Northern Nigeria increased the movement of food, reduced local shortages, and resulted in higher prices to producers. Crops such as coffee, rubber, and oil palms, which take some years to mature, were planted along the new route of a road planned in East Africa before construction began (Abbott, 1).

Table 73 shows that a somewhat greater number of countries with high agricultural growth rates also ranked higher in road mileage. The ranking has greater significance if the level of economic development as well as growth in general economic development is considered, i.e., putting in proper perspective the high road mileage ranking of countries like Japan and Greece. However, the overall quality of total road mileage differs rather widely between countries.

Storage

Lack of storage facilities in both quantity and quality is a major problem of the study countries, especially in many tropical countries. It has been estimated that from 5 to 10 percent of the world's food grain crop is lost annually because of faulty storage. Most of this loss occurs in countries with food deficits (Abbott, 1).

A study of grain marketing in the Yaqui Valley of Mexico showed no farm storage for wheat. All grain to be marketed was therefore transferred to government warehouses at harvest; more than one-third of the storage capacity required loading and unloading by hand labor; many storage units had relatively small capacity in terms of peak seasonal requirements; and because there were only five readily usable scales to serve a particular area, trucks loaded with wheat had to wait an average of 16 to 24 hours and a maximum of 36 hours for weighing.[26] Yet, relative to some less-developed countries, the Yaqui Valley of Mexico has highly developed market facilities.

Refrigerated storage and transportation are major problems for handlers of perishable crops. A report of cold storage development at Biher, an important potato growing area in India, furnishes an interesting picture of cost conditions. Only one cold storage unit was in operation in the early 1940's and the rental was $51 per metric ton per season. The second was established in 1946 and rental dropped to $45 per season. Continued addition of numerous cold storage units reduced charges to $40 in 1957, $34 in 1958, $28.50 in 1959, and $22.70 in 1960 (Abbott, 1).

[26] Rioseco, German, and Haag, Herman M., The Marketing of Grains in the Yaqui Valley. Southern Illinois Univ. Unpublished Ms.

Table 73.--Rating of 26 study countries by road mileage, size of urban market, and truck and bus facilities

Country[1]	Road mileage[2]	Size of commercial market[3]	Truck and bus facilities	
			Per person[4]	Increase[5]
	(1)	(2)	(3)	(4)
	Rating			
Israel	1	1	1	3
Sudan	3	3	3	1
Mexico	2	1	1	3
Costa Rica	1	1	1	NA
Philippines	2	2	2	3
Tanganyika	3	3	3	2
Yugoslavia	1	1	3	2
Taiwan	1	1	3	1
Turkey	2	3	2	1
Venezuela	3	1	2	NA
Thailand	3	3	2	1
Brazil	2	2	1	2
Greece	1	2	2	2
Iran	3	2	3	3
India	1	3	3	1
Poland	1	2	2	3
Argentina	3	1	1	2
Chile	2	1	1	3
Japan	1	1	1	1
Spain	1	1	2	2
Colombia	3	2	1	3
Nigeria	2	3	3	1
UAR	3	3	3	NA
Pakistan	2	3	3	1
Tunisia	2	3	1	2
Jordan	3	2	2	NA

[1] Arranged in descending order by growth rate in agricultural crop output in the 1950's.

[2] Ratings were based on miles of road per 1,000 square miles of area; over 400 miles ranked 1, 100 to 400 ranked 2, and less than 100 ranked 3.

[3] Based on proportion urban was of total population. 50 percent or more ranked 1, 40 to 49.9 ranked 2, and less than 40 ranked 3.

[4] Population per vehicle: 136 or less ranked 1, 136 to 338 ranked 2, over 338 ranked 3.

[5] Increases in number of trucks and buses 1958 through 1963 with highest increases ranked 1, medium increases 2, and lowest increases 3.

Lack of storage facilities is so important in many countries that there has been increasing pressure for government intervention and operation to avoid monopoly pricing. Pressures have sometimes led to a poor distribution of storage facilities. Some locations of public grain stores in Iran are inaccessible to producers (due to poor roads) and only a fraction of space is occupied. In another country, a specialist spent 2 years carefully developing location plans for storage units, only to be overruled by the head of the government who selected a different site. One government continued plans to build large cold storage units, despite expert reports which indicated no economic justification for

them. In several parts of Africa, meat-packing firms installed plants only to discover that the area could not supply enough livestock for efficient operations.

In summary, the study countries have devoted considerable efforts in recent years toward improving storage facilities for their farm products. The trend has been to favor public-owned and -operated facilities. However, acute need for more and improved storage facilities continues. Some countries have manifested a lack of effective storage planning, while planning in others has been well-directed. Effective planning, development, and use of storage in the areas of greatest need can produce large economies and can support agricultural growth.

Processing

Development of processing facilities has been instrumental in expanding market output in several nations. A well-known example is that of the influence of sugar mill establishments in Greece, Iran, Sudan, Uganda, Kenya, Tanganyika, Pakistan, and Chile.

Although simultaneous development of market facilities and farm output is sometimes most feasible for some products, for others the establishment of certain market facilities may best precede growth in output. Marketable surpluses seldom, if ever, precede the establishment of necessary market facilities.

In Mexico, construction of new strawberry freezing plants resulted in tremendous expansion of production after 1950 (67).

Production and export of citrus fruit have increased sharply in South Africa since 1957 as a consequence of expanding processing facilities. Forty-two plants--ranging in capacity from 5,000 to more than 30,000 tons--now process raw citrus fruit. Recently, a large plant was established which can handle 150 tons of oranges every 24 hours (65).

The development of canneries has enabled livestock producers in Kenya and Madagascar to gain access to outside markets. Such developments have also facilitated improvements in the quality of products.

Marketing Practices

Marketing practices in many less-developed countries can be vastly improved. Practices appear to focus on immediate transactions in buying and selling without regard to long-term considerations or to consumers' wants. These markets are bedeviled by many small-lot offerings. Therefore, assembly involves purchases from large numbers of growers for retail in very small amounts. Some common lots of retail purchases in Nigeria were "three lumps of sugar, half a cigarette, individual drops of perfume, and a few sticks of matches" (Mueller, 39).

In Thailand, much produce still moves to market centers on the farmer's head or shoulders, by bicycle or farm cart, and in baskets and bags (70). In Turkey, grain is taken to market in trucks, carts, and on donkeys (66). Palm-stem containers with sharp inside edges that damage the produce are used in the United Arab Republic. It is estimated that between one-third and one-half of all fruit and vegetables harvested in India are lost from poor handling. Peaches packed ripe spoil en route to market. Apricots sell for low prices because they are picked too green to attain full flavor (Abbott, 1). The quality of kenaf in Thailand is low because growers wet it in roadside ditches (70). In India, the palmyra fiber is sold by some farmers with sheaths beaten but fiber unextracted, by others with fiber extracted, by some with fiber given a preliminary combing before sale. Some farmers dry the fiber before selling, others sell it wet (Chaturcedi, 8). Farmers in the Philippines sell their corn crop in five forms (husked ears, unhusked ears, shelled, milled, and green) and in seven different units of sale (kerosene can, cavan, basket, cart, 100 ears, ganta, and individual ear). He further reported that fresh vegetables in a major area are packed field-run in flexible, loose-woven, split-bamboo containers holding 75

to 220 pounds and shipped 150 miles to Manila, and that losses range from 25 to 50 percent of shipping weight. Milk of very questionable quality is offered for sale in many parts of the world in ways that inhibit its consumption (Abbott, 1).

And so runs the picture from country-to-country. The economic results are reflected in a comparative study of egg marketing in Denmark and Iran (table 74). The price paid to producers in Iran was about half that paid to producers in Denmark, but the price consumers had to pay was about the same in both markets. A large proportion of the higher marketing margin in Iran was taken in collecting and assembling the eggs from the farmer through the wholesaler; less was taken by the retailer. Similar results are shown for a comparative study of meat marketing in Denmark, the United States, and Thailand (table 75).

Conditions and practices that affect bargaining often perpetuate problems. Quality marketing is discouraged if it is unrewarded by higher prices. Most of the countries charge farmers uniform prices, and give price discounts for impurities, shrinkage, or defects applied indiscriminately. Cattle are priced on basis of height in some areas of Central America. Eggs marketed in many parts of the study countries are surplus of small flocks kept for the family's home consumption; therefore, freshness, size, cleanliness, quantity, and quality are generally unregulated.

In many countries, the sale simply involves growers (or sellers) who gather in an open space for private bargaining with buyers. The sellers may be hampered for several reasons. Sellers often bargain without sufficient knowledge of other markets or other buyers. General market information for producers is often nonexistent. Bulletins on prices are sometimes issued too late to be of use. Indian market committees exhibit prices for their own and nearby terminal markets, but allowances for transport, marketing charges, and local demand-supply conditions would be necessary to translate them into a price the farmer could reasonably expect. The illiteracy of farmers and traders in many countries further limits use of printed market information. The intense pressures for immediate income which characterize many peasant cultivators accentuate the effects of these limitations. The pressures are so great that many growers commit the sale of

Table 74.--Comparison of marketing margin for eggs in Denmark and Iran

Item	Egg marketing price and margins	
	Copenhagen, Denmark (1955)	Tehran, Iran (1959)
	U.S. cents (per kg.)	
Price paid to producer	56.3	29.6
Price to wholesaler	61.8	53.4
Price to consumer	73.4	74.2
Total margin	17.1	44.6
	Percent	
From producer to wholesaler	32.2	53.4
Wholesaler's margin	4.1	13.4
Retailer's margin	63.7	33.2
Total margin	100.0	100.0
Margin as percent of consumer price	23.3	60.1
Margin as percent of producer price	30.4	150.7

Source: G. F. Steward and J. C. Abbott, Marketing Eggs and Poultry, FAO Marketing Guide No. 4, Rome, 1961, pp. 126-7.

Table 75.--Comparison of source of the marketing margin for meat in specified countries and years[1]

Source	Denmark (1956)	United States (1955)	Bangkok, Thailand (1958)
	Percent		
Farmer to livestock market.....	10.3	7.5	28.7
From livestock market to retailer....	12.6	8.6	25.6
Retailer's margin.....	77.1	83.9	45.7
Total margin.....	100.0	100.0	100.0

[1] Margins are for beef cattle in Denmark and the United States and for oxen in Thailand.

Source: R. F. Berdette and J. C. Abbott, Marketing Livestock and Meat, FAO Marketing Guide No. 3, Rome, 1960, pp. 186-7.

their produce for credit far in advance of harvest. Sellers may also be burdened by municipal regulation, taxes, and other charges (Abbott, 1).

The right to collect market charges is sold in some European, Latin American, and Asiatic countries. For example, in 1954 collection of municipal dues at the central market in Amman, Jordan, was reportedly "let" to a group of merchants for $84,000 while the sum collected that year was $182,000 (Abbott, 1).

There is considerable evidence that subsistence farmers can and will shift rapidly to cash crops if adequate price incentives are provided. It also appears that prices received by cultivators often provide them little incentive to increase output.

Market Development and Public Policy and Programs

Development planners have often placed disproportionate emphasis on expanding output at the farm level. As a result, too little attention has been devoted to improving the market structure needed to provide the economic incentives to increase output. It may be that efforts to improve farm production practices often get far less than full-hearted support from growers because of inadequate price incentives at the markets. Most less-developed countries have meager public capital to invest in efforts to increase agricultural output. In some cases it is probable that this capital would yield much greater returns if allocated to improving market facilities and practices rather than directly to improving crop yields.

Governments in some less-developed countries depend mainly on market regulations, subsidies, price regulation, and restrictive export and import measures that merely alleviate symptoms rather than market structure problems. Some of these public regulations are formidable barriers to development.

In most countries, market facilities and practices are generally best for export commodities and poorest for domestically consumed commodities. Standards for export commodities probably receive greater attention because of the demands for quality products in many of the importing countries. Whether priority in improving market facilities and practices should be given to domestic or to export products poses a very difficult problem and warrants special study.

Marked price instability in many underdeveloped countries inhibits production increases. Such instability can probably be lessened by improvement of market facilities and operation practices.

Research directed to solving specific marketing problems of underdeveloped countries is badly needed as these countries set out to modernize their agriculture.

CHAPTER 10.--AGRICULTURE IN THE ECONOMY OF UNDERDEVELOPED COUNTRIES

As the study countries develop, the farm share of the total labor force will normally decline (fig. 21). Thailand, with less than $200 per capita income in the mid-1950's, had over 80 percent of its labor force in agriculture; the United States, with a per capita income of $2,000, employed only 16 percent of its labor force in this activity. A general condition of sustained economic growth is that a declining proportion of the people is required to provide the food and fiber requirements of the total population (either by foreign trade, domestic production or both).

The farm share of gross national product usually declines with economic growth (fig. 22). In the mid-1950's, farm output was almost half the gross national product of India where per capita income averaged less than $100; but farm output was only 5 percent in the United States where per capita income averaged $2,000. Again, sustained economic growth requires increasing production and consumption of nonfarm commodities and services.

Agriculture's declining importance in use of manpower and contribution to total national product does not mean that the generators of economic growth lie solely in the industrial sector, or that agriculture can be ignored in development efforts or even that agriculture is becoming less important to the economy. Rather, growth in nonfarm sectors normally requires that agriculture produce an increasing supply of foods and fibers with a decreasing share of the nation's manpower and other resources. Especially in the early stages of their economic growth, most countries must improve the performance of their agricultural sector.

The Surplus Product Contribution

How well has agriculture's recent performance in less-developed countries contributed to their general economic development? There has been some correlation between rates of increase in per capita agricultural output and rates of increase in per capita incomes in the study countries since 1948 (fig. 23). The rate of growth in agricultural output exceeded the rate of growth in the population (referred to as surplus) in the 1948-63 period in 21 of the 26 countries (column 3, table 4), and thus all countries except Egypt, Pakistan, Tunisia, Nigeria, and Jordan were producing surplus agricultural produce. Further, the surplus potential exceeded an annual growth rate of 1 percent in 18 of the 26 countries.

There are many complex factors at work that have both negative and positive effects on national income growth. These tend to obscure efforts to relate the agricultural surplus growth to per capita income growth. Nevertheless, all 9 countries with a 3-percent or greater per capita income growth rate had positive agricultural surplus growth rates; the annual surplus growth was less than 1 percent in only 1 of those countries. In contrast, of the 15 countries with per capita income growth rates of less than 3 percent, 6 had agricultural surplus growth rates of less than 1 percent; of these, 3 were negative, i.e., agricultural output grew less than population. The data support the proposition that the agricultural surplus makes a positive contribution to general per capita income growth in less-developed countries.

Uses to which the agricultural surplus was put cannot be easily determined from available data. The annual rate of increase in total demand for food was compared with the rate of increase in agricultural output (see Chapter 1, table 5). Results indicate that in 12 of the 21 countries the surplus product was not sufficiently large to meet the increased demand for food, and that in another (Turkey) it was just adequate. Roughly one-third of the countries produced an agricultural surplus large enough to more than

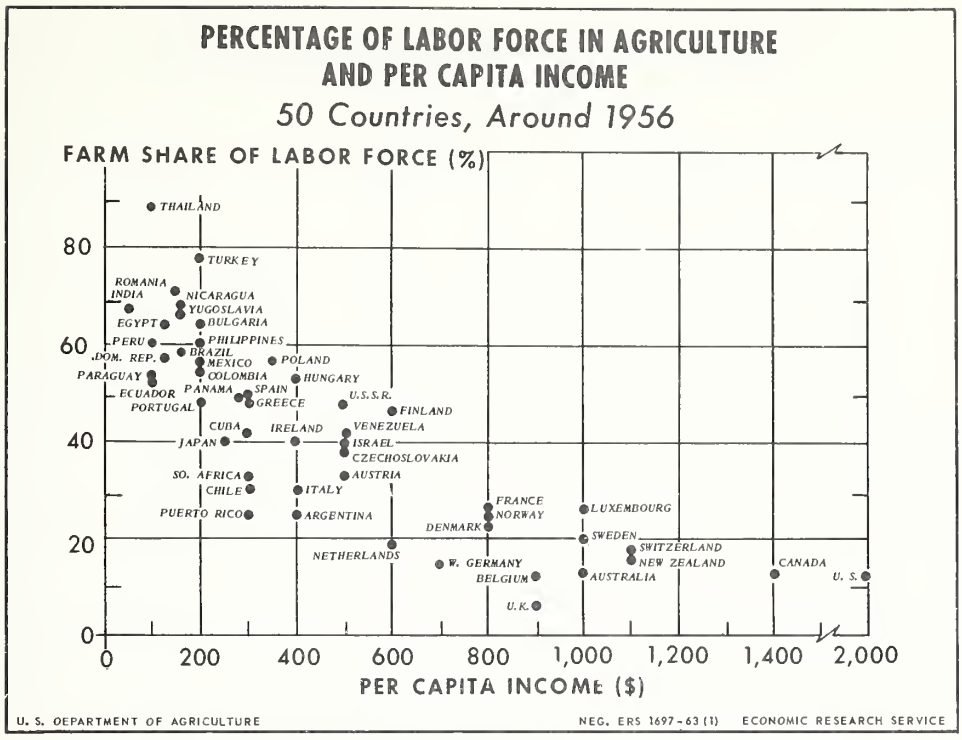

Figure 21

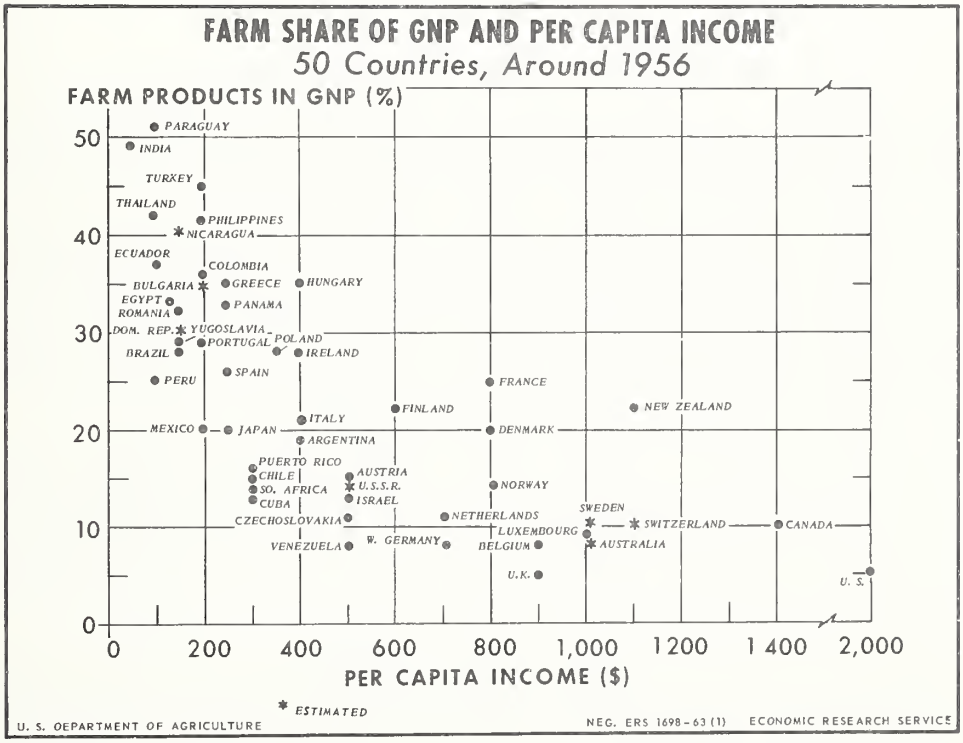

Figure 22

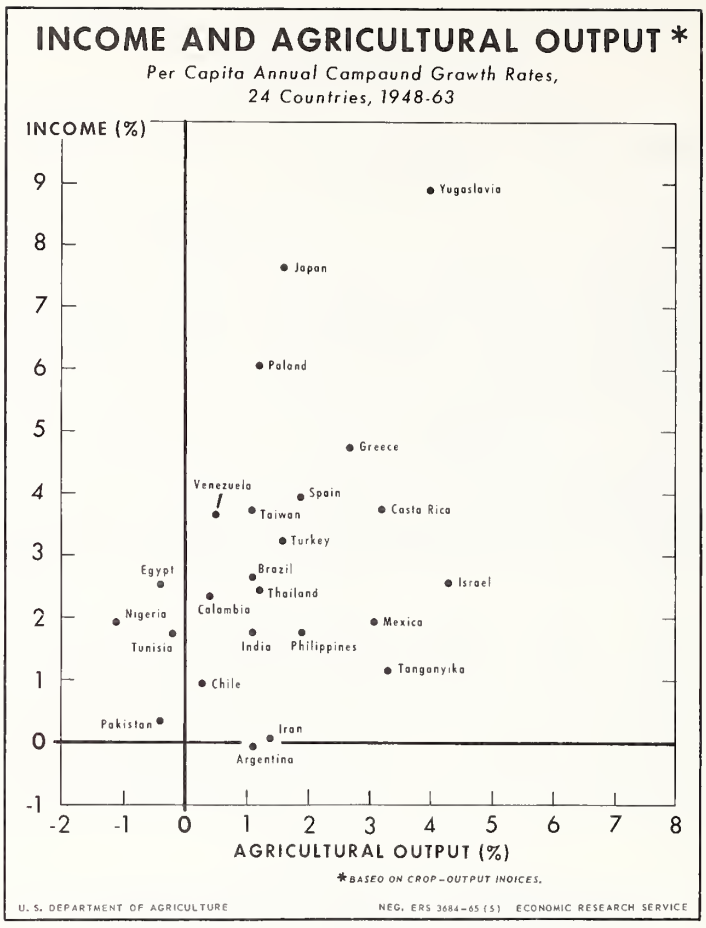

Figure 23

meet rising per capita agricultural product requirements. Such surpluses, however, are not automatically channeled into capital improvements, but often have to be diverted into capital uses through tax measures and other special policies and programs.[27]

Data on the export and import of agricultural products during the period 1956-60 for 12 countries (table 76) show the importance of agriculture in foreign exchange earnings. Only 2 countries (Yugoslavia and Japan) had imports exceeding exports during the period. The other 10 showed agricultural exports producing a trade balance for support of imports other than agricultural products--and in some cases of a sizeable amount in relation to total national income. The net trade balance ranged from 10 to 18 percent of national income in Costa Rica, Thailand, Argentina, and Nigeria.

In Brazil and Colombia, the rate of agricultural output growth in the latter part of the decade was sufficiently higher than in the first part to support a large trade balance. It was slightly greater than demand growth in Thailand. Nigeria and Egypt had rather large trade balances earned by agriculture, but this estimated domestic demand was growing faster than agricultural output. Consequently, the volume of net exports could only be maintained if actual domestic consumption were below the levels estimated.

A relatively small portion of the foreign exchange earnings of agriculture in all countries (except in Greece, 47 percent, and Spain, 87 percent) is used to import agricultural capital and productive items (table 77). Most of it was available to import the

[27] Assuming, of course, that a sufficiently large export-import balance did not exist prior to the beginning of the period that could be drawn on to supplement the "less-than-needed" surplus being produced in the 1950's.

Table 76.--Agricultural trade balance and crop output minus demand growth rate balance, selected countries, 1956-60

Country	Agricultural trade balance		Crop output less demand growth[3]
	1956-60, annual av.[1]	Percentage of national income[2]	
	Million U.S. dollars	Percent	Percent
Costa Rica	65.7	17.8	1.1
Yugoslavia	-45.6	-0.1	-1.3
Turkey	220.7	2.0	0.0
Thailand	246.0	13.4	-0.5
Brazil	950.1	5.3	-0.2
Greece	57.2	2.3	0.4
Japan	-1,275.0	-5.1	-2.8
Argentina	841.9	11.5	1.1
Spain	69.3	1.2	-0.3
Nigeria	276.6	10.2	-2.3
Colombia	327.6	8.2	-0.9
UAR	224.6	7.4	-2.0

[1] FAO Yearbook of Trade Statistics. Agricultural products exported minus agricultural products imported.
[2] Agricultural trade balance as a percent of total national income, 1956-60.
[3] From column 3, table 5, Chapter 1.

Table 77.--Trade balance of agricultural products and imports of agricultural requisites, 1956-60 average

Country	Trade balance of agricultural products	Imports of agricultural requisites[1]	
		Value	Percentage of trade balance
	Million U.S. dollars	Million U.S. dollars	Percent
Costa Rica	65.7	8.0	12.2
Yugoslavia	-45.6	46.9	([2])
Turkey	220.7	10.9	4.9
Thailand	246.0	7.3	3.0
Brazil	950.1	78.5	8.3
Greece	57.2	26.9	47.0
Japan	-1,275.0	10.0	([2])
Argentina	841.9	41.4	4.9
Spain	69.3	60.1	86.7
Nigeria	276.6	6.6	2.4
Colombia	327.6	28.7	8.8
UAR	224.6	36.2	16.1

[1] Net of requisites exported which was insignificant for most countries except Japan.
[2] Negative trade balances.

requisites and raw materials to support development in nonagricultural industries. Part of the agricultural surplus was apparently used to support higher per capita consumption of foods and fibers.

Labor Supply and Demand Stimulant

What can be said about agriculture's role in supplying labor resources to support nonagricultural industrial growth? Here, too, we must depend on partial data and intuitive judgment.

One viewpoint assumes an economy which is operating with a fully employed working force. There is a contrary view, that most underdeveloped countries need not be concerned (especially in early stages) about quantitative limitations of labor. While lack of certain qualities of labor (skilled, semi-skilled, and managerial) provide potential obstacles to development, it is believed that manpower in general is in plentiful supply for development purposes.

Available data indicate that manpower is shifting out of agriculture in the less-developed countries. The economically active population that made this shift from 1950 to 1960 was about one-sixth of the total economically active population in the nonagricultural sectors of 12 countries in 1960 (table 78). This assumes that the rate of rural population growth was the same as for total population. However, omitting Japan, only a tenth of the 1960 population that was economically active in nonagricultural sectors of the other countries came from agriculture. The proportion ranged from 7 to 22 percent for individual countries.

Table 78.--Approximate contribution of agriculture to nonagricultural working force for selected countries, 1950 and 1960

Country	Economically active in agriculture			Workers released from agriculture	
	1950[1]	1960[1]	Projected 1960[2]	Number[3]	Percentage economically active in nonagriculture
	1,000	1,000	1,000	1,000	Percent
Mexico	4,824	6,145	6,532	387	7.5
Philippines	4,875	5,383	5,990	607	15.0
Yugoslavia	5,240	4,748	5,571	823	22.9
Venezuela	705	774	994	220	13.6
Turkey	10,744	9,737	11,053	1,316	7.3
Thailand	7,624	11,334	11,730	396	15.8
Greece	2,006	1,938	2,293	355	20.8
Poland	7,090	6,541	7,937	1,396	19.0
Japan	17,220	14,346	20,845	6,499	21.9
Spain	5,271	4,803	5,751	948	13.9
UAR	4,126	4,403	4,939	536	15.9
Malaya	1,228	1,245	1,394	149	16.2
Total	70,953	71,397	85,029	13,632	16.1

[1] Computations were based on nearest year to 1950 and 1960 for which data were available.

[2] Assuming that the number of workers economically active in agriculture increased at the same rate as total population, and assuming the same proportion of total population economically active in 1950 as in 1960.

[3] Projected 1960 minus the 1960 actually active in agriculture.

The extent to which agriculture can release labor for nonfarm uses depends mainly on the relative proportion of the total labor force in agriculture, the extent to which farm output can be increased through increasing productivity, and the ability of the nonfarm sector to employ laborers. Japan, for example, has been contributing large numbers of rural people to urban industries because of its rapid improvements in output per man unit in agriculture.

Agriculture's Market Contributions

As agriculture increases per capita supplies of farm products, the resulting decline in food prices releases income for other uses and thereby functions as a market stimulant for nonfarm goods and services.

Increased farm use of purchased production requisites, such as insecticides and improved seeds, also opens up market opportunities for nonfarm sectors.

Available information on agriculture's market contributions indicates that agriculture has contributed indirectly to the growing market for nonagricultural output. It has achieved this end by providing more foods and fibers at relatively lower prices, and by its own purchases of agricultural production requisites. Its contribution to growth in markets for nonagricultural consumer products and services is more difficult to ascertain. The fact that the agricultural portion of total national income is usually considerably less than its portion of the total working force would suggest that increases in the income of people in agriculture may support stronger demand for consumption goods than for savings and investment.

CHAPTER 11.--CONCLUSIONS

Most of the world's less-developed countries can sufficiently increase their food and fiber production within the next 10 or 20 years to satisfy their increases in demand, and still have enough surplus to contribute substantially--through trade and nonfarm employment--to their general economic development.

Several of the study countries have already begun to increase their agricultural output at higher rates than those ever achieved over a long period of time in any of the now economically advanced nations. These include Israel, Sudan, Mexico, Costa Rica, the Philippines, Tanganyika, Yugoslavia, Taiwan, Turkey, Venezuela, Thailand, and Brazil. All of these countries had higher rates of increase in both the 1948-55 and the 1955-63 periods than the United States had in the decades of its most rapid rate of increase--the periods 1880-1920 and 1935-60 (table 4, Chapter 1).

The experiences of these countries constitute evidence of the possibility of improving agriculture in less-developed countries generally. Large differences among them in many factors crucial to agricultural progress enhance the value of such evidence. Some of these countries lie in tropical and semitropical zones and some in temperate regions (fig. 1). Some differ greatly in their rural population densities, arable land expansion potentials (table 14), stage of economic development, and cultural features. Some have had much lower per capita incomes (table 6) as bases for capital accumulation, much lower levels of literacy, and much less adequate educational systems for improving skills and management abilities than other sample countries.

These observations open to question some earlier views on the agricultural development prospects of underdeveloped countries. Most of these views are subsumed under the doctrines of geographic and economic determinism. According to geographic determinism, underdeveloped countries have remained underdeveloped because of their relatively unfavorable natural endowments. According to economic determinism, they have remained poor because they are in a vicious circle of cause-effect relationships. In this circle, such ills as illiteracy, malnutrition, disease, and superstition "cause" low output and incomes, and low output and incomes "cause" these social ills, yielding a pattern of "causes of causes" and making for a traditional society in a low-income static equilibrium.

Soils, climate, literacy levels, existing stocks of capital, cultural patterns, values, world markets for agricultural commodities and other such physical, social, and economic conditions--all these are hard facts that cannot be ignored as underdeveloped countries set out to increase their agricultural output and productivity. What these conditions mean, however, for improving agriculture is not inherent in such conditions themselves. Rather, the meaning is heavily dependent upon what responses and adaptations are made to these conditions. Such responses and adaptations are the essence of what is meant by the terms policies and programs, and these--far more fully than soils, climate, language, and present literacy and income levels--are the true determinants of what we call modern economic growth.

Because of the necessity to build upon foundations laid in the past, less-developed countries cannot reasonably expect to achieve quickly agricultural output levels as high as those in much more economically advanced nations. In fact, even if farmers in countries like Pakistan and India were suddenly to produce as much physical output per farm worker as do farmers in the United States, it might still take years to build the transport, processing, and market facilities, the farm-industry or farm-nonfarm employment balances, and the other supply-demand conditions needed to convert this increased abundance into valuable economic assets.

Therefore, present low levels of development mitigate the need in underdeveloped countries to raise levels of agricultural productivity to those now achieved in economically advanced nations. The immediate needs of less-developed countries are not such high levels of agricultural productivity, but rates of increase in their agricultural output and productivity commensurate with their population growth rates and with their capacity to use such increases for general economic growth.

For the purposes of achieving such rates of increase, less-developed countries have some very distinct advantages and disadvantages relative to those of now advanced nations in the early stages of their development. Their major disadvantages lie in their poverty and related resource bases which lessen their capacity to compete with economically advanced countries.

Yet the fact that these countries have long had low incomes and levels of living can itself facilitate the use of any increases in per capita production and incomes to finance further development--so long as they initiate appropriate policies and programs. In the interim between the Meji Restoration in 1868 and its entry into World War II, Japan was able, through direct taxation of its farmers, to draw off a large part of its increases in agricultural productivity for its general economic development. Increases in productivity can also be drawn off indirectly through taxes and import restrictions on nonessential consumer goods, governmental purchase, resale and export of major farm commodities, improvements in incentives to save and invest, education, and possibly other measures.

Because of their retarded technologies less-developed countries also have large underutilized human and land resource potentials. These potentials can become relatively cheap sources of output and income increases if and when the improved technologies developed elsewhere are applicable to their agriculture. Important farm technological transfers have already been made from economically advanced to less-developed countries, particularly into their export sectors. This suggests that market demand, organization, and entrepreneurship--rather than inadaptability to physical environment--are critical to the successful transfer of at least some important improved technologies (Hirschman, 26).

As a source of demand, most of the less-developed countries have in their own population growth and rising per capita incomes market bases for much larger rates of increase in output than those achieved in the United States in the periods of its most rapid agricultural progress. In fact, in a few countries, instead of the lack of enough general economic growth to generate enough demand for farm output increases, the rate of general economic growth has probably been slowed down because of slow rates of increase in agricultural output and productivity.

Increasing agricultural output for both domestic consumption and export is particularly important for the economic development of less-developed countries. General economic growth and associated rising per capita incomes yield proportionately large per capita increases in the demand for food in low-income countries because of high elasticities of demand. Failure of food sectors to meet the growth in food demand being generated by development normally leads to rising food prices and labor costs. And because these economies are so heavily labor-based, increased food prices quickly set off inflationary pressures that stymie further economic growth.

Expansion of agricultural exports as a source of the foreign exchange with which to buy imports is particulary important in early stages of development because economic development greatly increases demand for imports of both consumer and capital goods, especially the latter. Foreign exchange with which to finance such imports can be generated in part by industrial exports. On balance, however, industrial sectors of newly developed nations commonly generate much larger increases in demand for foreign exchange than in their foreign exchange earning capacities (Patel, 44). This is so in part because of needs in developing stages for large amounts of capital in long-term investments. The more important reason, however, is that industrial sectors tend to concentrate on goods for domestic consumption rather than for export. Even so, they are often heavily dependent upon high import duties and other import restrictions to compete successfully for their own markets with industrial sectors of economically advanced countries.

Expanding the output of primary commodities for exports with which to finance imports of capital goods has always been and will probably continue to be critical to the general economic development of less-developed countries. Exportable primary commodities are limited mainly to agricultural commodities, except in a few countries with large, relatively accessible deposits of mineral resources. Hence, failure of less-developed countries to furnish in early development stages an ever-increasing supply of exports and export earnings can have near fatal consequences for their development aspirations. When this happens in an underdeveloped country, it may appear that the agriculture of that country is lagging because of insufficient growth in domestic demand; but the actual reason may lie in the critical foreign exchange shortage associated with a decline in value of agricultural exports.

The resource gaps now existing between less-developed and economically advanced nations in both their farm and nonfarm sectors are exceedingly large. Closing these gaps may be a prerequisite to closing output and productively gaps between underdeveloped and advanced nations. Closing such gaps, however, can only be accomplished over a long period of time and then only by now setting off higher sustained rates of growth than economically advanced countries have. Fortunately, the amount of additional resources required by less-developed countries to achieve these higher rates is only a very small fraction of that needed to reach the agricultural productivity levels of economically advanced nations. In short, resource limitations to agricultural progress in less-developed countries are neither so large nor so critical as differences in resources between developed and underdeveloped countries appear to make them.

For example, since 1948, relatively high rates of increase in agricultural output have been achieved by such countries as Sudan and Tanganyika. Few less-developed countries have more disadvantages than these two countries in their supply of capital and skills. Tanganyika also lies in a tropical region for which needed technological bases for progress have been widely presumed to be virtually nonexistent.

Less-developed countries can overcome their resource limitations by using their available resources as fully and as effectively as possible, and by diverting some of the resulting increases in output to building up their capital stocks. This is mainly a matter of will and organization. Organizational impediments to efficient utilization of resources are numerous and complex. In some countries, they include semi-feudal or tribal land tenure systems incapable--without drastic modification--of providing the flexibility, degree of individual freedom, and incentives for a high rate of innovations required for progress. Some have governmental systems which lack enough political stability, administrative machinery and personnel, or constitutional powers to improve agricultural production conditions. In some cases, the distribution of powers between central, state, and local governing bodies is poorly defined, or defined in ways which prevent action that each could otherwise take.

Tax powers of government at all levels are frequently inadequate to finance ordinary functions of government and to divert more income into savings and investment.

To maintain high rates of increase in agricultural output and productivity, most of the study countries need to improve their educational and research foundations, agricultural credit institutions, and transport, communication, and marketing facilities. They need also to improve their available sources of fertilizers, seeds, pesticides, farm implements, and other production requisites.

Governmental and private sectors can also contribute to improvement of production incentives. Governmental sectors have most frequently made this effort through price support and stabilization programs. In countries with large landed monopolies, improving production incentives can also be done through land tenure changes, through betterment of supply conditions, and through breaking down physical and institutional barriers to trade and communications.

What we offer in this study, however, are not specific prescriptions for individual countries, but generalizations on a large number of important factors as seen by comparing less-developed countries with each other. This study enables each country to look at its own agricultural development needs, potentials, and problems against those of other less-developed countries, as well as against experiences of the economically advanced nations. Comparison of less-developed countries with countries at similar economic stages rather than with economically advanced nations results in more discernible possibilities for their progress.

However, it should be recognized by persons using this report that the 26 study countries do not represent a random sample of the world's less-developed countries. Yet, they do encompass a wide variety of conditions and approaches to agricultural and economic development.

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APPENDIX I

AN ILLUSTRATION OF USES OF THIS PUBLICATION IN AGRICULTURAL DEVELOPMENT PLANNING

Purpose

This section is directed mainly to policymaking and administrative personnel concerned with the role and performance of agriculture in newly developing nations. It is offered as an example of how such officials can use the major findings of this study to evaluate their own agriculture.

Method

The example applies the comparative or cross-sectional approach to a single country, the Philippines. Choice of this country as our illustration was an arbitrary one. Any other less-developed country--including any not in the study sample--would serve equally well, for the only requirement was the availability of relevant information.

In table 79, the Philippines are compared with other countries in the study sample on 26 selected items. More statistical detail on many of these items is provided in the report, usually from the same sources as shown in column 10 of this table.

We have first listed data on five items relating to the whole economy of the Philippines. These include, in order, indicators of (1) per capita incomes, (2) rates of increase in per capita incomes, (3) population growth rates, (4) rate of growth in the country's domestic food demand, and (5) percentage of this growing demand accounted for by population growth rather than by rising per capita incomes.

Items 6 and 7 show the relative importance of agriculture in the nation's economy at a given point in time. By themselves these items do not completely elucidate interrelationships between agriculture and the rest of the economy, but they are useful in the analysis of such relations.

In items 8, 9, and 10, we turn to the performance of the agricultural sector as indicated by annual rates of increase in agricultural production; these increases are relative to growth in population and in food demand.

Items 11 and 12 indicate the role of agriculture as a source of foreign exchange earnings needed to meet increases in the demand for imports of both capital and consumer goods.

Items 13 through 18 provide a basis for gauging levels and changes in productivity or efficiency of the nation's agricultural sector.

Items 19 through 25 show some of the key factors which influence levels and changes in agricultural output and productivity.

Table 79.--Comparison between Philippines and other study countries in selected variables

Item	Number of countries reported	Unit of measure	Philippines	Most favorable country	Least favorable country	26 Study Countries: Countries excelling Philippines[1]: Other Far East countries	26 Study Countries: Countries excelling Philippines[1]: Other sample countries	Source of data
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Gross domestic product per capita, 1958.....	22	U.S. dollars	113	905	57	Japan	Israel, Venezuela, Poland, Argentina, Chile, Spain, Mexico, Greece, Turkey, Costa Rica, Colombia, Yugoslavia, UAR, Brazil	table 67
2. Annual increase in real per capita income, 1950-60.....	26	percent	1.7	8.9	-0.1	Japan Taiwan Thailand	Yugoslavia, Poland, Greece, Spain, Costa Rica, Venezuela, Turkey, Brazil, UAR, Israel, Colombia, Mexico, Nigeria	table 2
3. Population growth rate, 1950-60.....	26	percent	3.2	0.8	5.2	Japan	Spain, Greece, Yugoslavia, Argentina, Tanganyika, Poland, Tunisia, India, UAR, Colombia, Pakistan, Iran, Chile, Jordan, Turkey, Mexico, Brazil	table 4
4. Annual rate of increase in domestic food demand.	26	percent	4.48	6.6	1.7	Taiwan Japan Thailand	Israel, Yugoslavia, Venezuela, Poland, Nigeria	table 2
5. Part of increase in domestic food demand accounted for by population growth.....	26	percent	71	17	101	Japan Taiwan Thailand	Yugoslavia, Spain, Greece, Poland, Costa Rica, UAR, India, Tunisia, Colombia, Venezuela, Turkey, Brazil, Jordan	table 5
6. Population in agriculture.....	20	percent	69	18	92	Japan Taiwan Thailand	Israel, Argentina, Venezuela, Poland, Chile, Colombia, Spain, Yugoslavia, Greece, Mexico, Iran, UAR	table 50
7. Gross domestic product originating in agriculture, 1960.....	21	percent	33	9	59	Japan	Venezuela, Israel, Chile, Argentina, Mexico, Yugoslavia, Poland, Spain, Brazil, Greece	table 67
8. Annual compound increases in crop output.....								
a. 1948-63.....	26	percent	5.2	9.7	-1.9	none	Sudan, Mexico, Costa Rica	table 4
b. 1948-55.....	26	percent	8.1	15.9	-2.2	none	Israel, Sudan, Mexico	table 4
c. 1955-63.....	26	percent	3.2	7.9	-1.9	Thailand Taiwan	Costa Rica, Sudan, Israel, Brazil, Venezuela, Yugoslavia, Colombia, Mexico, Poland, Iran	table 4

Table 79.--Comparison between Philippines and other study countries in selected variables--Continued

Item	Number of countries reported	Unit of measure	Philippines	Most favorable country	Least favorable country	26 Study Countries: Countries excelling Philippines[1]: Other Far East countries	26 Study Countries: Countries excelling Philippines[1]: Other sample countries	Source of data
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
9. Annual compound increases in crop output per capita of total population								
a. 1948-55	26	percent	4.9	10.7	-4.5	none	Israel, Sudan, Mexico, Yugoslavia	table 4
b. 1955-63	26	percent	0	3.8	-4.3	Thailand Taiwan Japan	Costa Rica, Yugoslavia, Sudan, Israel, Spain, Brazil, Poland, Colombia, Tanganyika, Argentina, Mexico, Venezuela, Greece, Iran, India, Nigeria, Pakistan, UAR, Turkey	table 4
10. Amount that annual compound growth in crop output exceeded that in domestic food demand, 1955-63	26	percent	-1.3	3.4	-5.6	Thailand	Costa Rica, Sudan, Argentina, Colombia, Brazil, Iran, Tanganyika, Pakistan, Spain, Mexico, India, Chile, Israel, UAR	table 5
11. Increase in agricultural exports, 1950-60	25	percent	139	2259	89	Japan Thailand	Israel, Tanganyika, Iran, Yugoslavia, Mexico, Tunisia, Argentina, Greece, Jordan, Sudan, Spain, Nigeria, India	table 68
12. Change in ratio of agricultural exports to agricultural output (1960 as percent of 1950)	25	percent	84	896	64	Japan Thailand	Israel, Tanganyika, Iran, Jordan, Yugoslavia, Tunisia, Argentina, Spain, Mexico, Greece, Nigeria	table 68
13. Agricultural output per hectare, 1960	22	U.S. dollars	139	961	39	Japan ($961) Taiwan ($477)	UAR ($643), Israel, Costa Rica, Colombia, Poland, Greece ($205), Venezuela, Spain, Yugoslavia ($141)	table 67
14. Agricultural output per agricultural worker, 1960	19	U.S. dollars	181	1825	94	Japan Taiwan	Israel, Argentina, Spain, Poland, Chile, Colombia, Venezuela, Greece, Mexico, UAR, Turkey, Yugoslavia, Brazil, Pakistan	table 67
15. Increase in area of crops, 1948-62	22	percent	66.9	68.5	-0.9	none	Israel	table 9
16. Annual average yield of rice per hectare, 1961/63	19	100 kilograms	12.2	62.5	12.2	Japan (50.5) Taiwan (32.1) Thailand	Spain, UAR, Greece, Turkey, Yugoslavia, Argentina, Chile, Mexico, Iran, Colombia, Brazil, Pakistan, Venezuela, India	table 34
17. Increase in crop yields, 1948-62	22	percent	9.8	120.4	5.9	Taiwan Japan Thailand	Israel, Sudan, Colombia, Greece, Yugoslavia, Spain, Poland, Mexico, UAR, Argentina, Turkey, Tanganyika, Venezuela, Iran, India	table 9

Table 79.--Comparison between Philippines and other study countries in selected variables--Continued

Item	Number of countries reported	Unit or measure	Philippines	Most favorable country	Least favorable country	26 Study Countries: Countries excelling Philippines[1]: Other Far East countries	26 Study Countries: Countries excelling Philippines[1]: Other sample countries	Source of data
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
18. Arable land expansion potential.....	21	[2] rating	IV	I	IV	Thailand	Brazil, Sudan, Tanganyika, Colombia, Venezuela, Argentina, Iran, UAR, Chile, Mexico	table 14
19. Fertilizer nutrients used per hectare of arable land, 1962/63...	26	kilograms	9.4	270.1	0.5	Japan Taiwan	UAR, Costa Rica, Israel, Greece, Poland, Yugoslavia, Spain, Chile, Brazil, Colombia, Mexico	table 35
20. Increase in fertilizer nutrients per hectare of arable land, 1948/52 1952/53 to 1962/63.....	23	kilograms	2.7	125.3	0	Japan Taiwan	Israel, Greece, Costa Rica, UAR, Yugoslavia, Poland, Spain, Mexico, Brazil, Chile, Colombia, Pakistan, Venezuela, India	table 35
21. Literacy level for population 15 years and over.....	26.0	percent	75.0	98.0	7.0	Japan	Israel, Poland, Spain, Argentina, Chile, Greece, Costa Rica, Yugoslavia	table 54
22. Percent of holdings owner-operated.....	16	percent	58	96	34	Thailand Japan Taiwan	Greece, Jordan, Costa Rica, UAR, Mexico	table 21
23. Agricultural credit from institutional sources.....	8	percent	12	80	10	Japan Thailand	Mexico, Venezuela, Pakistan, India	table 59
24. Quality of agricultural marketing facilities...	26	[3] rating	2	1	3	Japan Taiwan	Israel, Mexico, Costa Rica, Yugoslavia, Venezuela, Argentina, Chile, Spain	table 7, column 17
25. Change in ratio of agricultural wholesale prices to general wholesale prices (1960 as a percent of 1950)..	9	percent	95	125	87	Japan (125%) Taiwan (120%)	Israel (117%) Mexico, Costa Rica, Iran (103%)	table 68
26. Change in ratio of agricultural wholesale prices to world unit values (1960 as percent of 1950).....	9	percent	118	1969	118	Taiwan Japan	Chile, Brazil, Israel, Mexico, Iran, Costa Rica	table 68

[1] Listed in descending order.
[2] The ratings I, II, III, and IV indicate increases in arable land over area now in use of more than 150 percent, 75-149 percent, 25-74 percent, and under 25 percent, respectively.
[3] The ratings 1, 2, and 3 indicate most favorable, moderately favorable, and least favorable, respectively.

Analysis

The Philippine Republic, with a GNP in U.S. dollars of only $113 per capita, ranks low among nations of the earth in per capita income and even among less-developed nations (item 1). It also ranks low in its recent rate of progress in increasing its income and welfare levels (item 2). The Philippine Republic must expand its total economy at a fairly rapid rate merely to accommodate a rate of population increase (3.2 percent) that is one of the highest in the world (item 3). If this rate continues, its population will double in less than 20 years. The country's domestic food demand is increasing at about 4.5 percent a year (item 4). This increase in food demand has resulted primarily from the nation's population growth rather than from an effective rising per capita food demand, such as commonly results from rising per capita income (item 5). The nation's food consumption per capita per day is substantially below the desirable level (see table 1, Chapter 1).

All of these facts suggest that, as a whole, the Philippine economy will slip into a lower rank among nations of the earth in its income and welfare levels, unless it begins a massive drive for an accelerated rate of general economic growth.

In such a drive, agriculture must play an important role--if only because nearly 70 percent of the nation's population is in agriculture (item 6) and because agriculture accounts for a third of its gross national product (item 7). An improved agriculture is badly needed to correct the country's food consumption deficits and to provide increased exports. Usually, rapid development of the industrial sectors of newly developing nations increases the demand for imports faster than these sectors can increase their export capacities. This means that primary industry sectors, which for the Philippines consist mainly of agriculture, must have a large share in net increases in its foreign exchange earnings (see Chapter 11).

A study of the recent performance of the country's agricultural sector shows that between 1948 and 1955 its crop output increased at the rate of 8.1 percent a year; this rate was exceeded by only 3 other countries in the study sample. Since 1955, however, the annual rate of increase in crop output has dropped to 3.2 percent (item 8). This percentage is the same as the country's rate of population growth (item 9). It is below the growth in its own per capita food demand, which is being generated by population growth and small increases in per capita income (items 10 and 11).

Compared with most of the other study countries, Philippine agricultural exports have increased very little percentagewise during the last decade (item 11). In fact, as a result of the combination of increases in the country's own internal food demand and its slow rate of increase in its agricultural output, its ratio of exports in 1960 declined to 84 percent of the ratio in 1950 (item 12). Since 1955, therefore, Philippine agriculture's performance has not been adequate either to improve the country's per capita food consumption or to increase foreign exchange earnings substantially.

To what extent, if any, is the nation's recent slow rate of general economic growth, as measured by increases in per capita incomes (item 2), linked causally to the recent performance of its agriculture? Certainly, the nation's own population growth and rising per capita incomes have provided a market basis for absorbing larger increases in agricultural output than have been made.

Among the study countries, the Philippine Republic ranks low in agricultural output both per hectare of arable land (item 13) and per agricultural worker (item 14). Since 1948, the area of crops has increased 67 percent--more than in any other study country except Israel. Crop yields in the Philippines, however, are very low (item 16) and have increased very little since 1948 (item 17).

The nation's arable land expansion potential with known technologies is quite limited (item 18). In the years ahead, therefore, increasing output per unit of land in use through multiple cropping and higher yields per hectare of crops will be necessary to increase its agricultural output. Information on multiple cropping and its potentials has not been available for this study.

Available information indicates that Philippine agriculture ranks low among the study countries in use of yield-increasing techniques of the kinds that have proven successful in Taiwan, Japan, Sudan, Egypt, and other countries. Its consumption of fertilizer nutrients per hectare of arable land was only 9.4 kilograms in 1962/63, less than in 13 other study countries. Since 1948, it has been exceeded by 16 other study countries in increases in kilograms of fertilizer nutrients per hectare. Data on quality of seed used in the Philippines have not been available, but apparently there has been little improvement in varieties of its major crops.

Whether the Philippine Republic has had an available technological basis for increasing yields cannot be definitively established from existing secondary information. Experiences of other less-developed countries in increasing yields, however, suggest technological foundations which, even if not sufficient to raise levels to those in Japan and Taiwan, could help to set off higher rates of increase in yields than the Philippines have had.

In educational levels, the Philippine Republic ranks high among the world's less-developed nations (item 21). It has made progress in improving its land tenure patterns, but still has need for major land tenure adjustments (item 22). Relative to many other less-developed countries, it has rather mediocre market and transportation facilities (item 24). This is reflected in a high degree of price variability, both spatially and over time, for Philippine farm products. Like many of the less-developed countries, it appears to have poorly developed agricultural credit facilities.

A critical factor in the Philippines during the 1950's was the deterioration in the terms of trade between agriculture and nonagricultural sectors; this is indicated by changes in the ratio of agricultural prices to the general price level (item 25). This deterioration has not been explored here, but it probably accounts in part for the poor performance of Philippine agriculture. Terms of trade have improved since 1960.

The above discussion illustrates the uses to which the information provided in this report can be put, and suggests directions that need to be taken to improve agriculture. In such analyses, it may frequently be desirable to go into more detail than was done here. In all cases, statistics presented in this report will need to be supplemented by the kind of knowledge which comes from long, intimate associations with the agricultural problems of each country.

APPENDIX II

STATISTICAL TABLES

Table 80.--Value of agricultural output, 26 study countries, 1960

Country and area	Agricultural output, 1960, in--					Per capita agricultural output, 1960 as a percentage of 1950
	Local currency terms		U.S. dollars			
	Unit	Amount	Parity exchange rate per U.S. dollar	Total value	Per capita value	
		Millions	Units	Millions	Dollars	Percent
Latin America						
Argentina...	pesos	159,700	68.4	2,334.8	117	112
Brazil.....	pesos	536,000	172.5	3,107.2	44	111
Chile.....	pesos	475.6	1.346	353.3	48	103
Colombia....	pesos	8,553	6.33	1,351.2	96	104
Costa Rica..	pesos	820.7	8.55	96.0	82	137
Mexico.....	pesos	25,933	11.8	2,197.7	63	135
Venezuela...	pesos	1,879	5.00	375.7	51	105
Europe						
Poland.....	zloty	96,700	.042	4,029.2	136	112
Spain.....	pesetas	152,700	48.5	3,148.4	103	121
Yugoslavia..	dinars	742,000	.0016	1,174.1	64	146
Near East & South Asia						
Egypt.....	pound	559	.348	1,606.3	62	96
Greece.....	drach	23,827	31.4	758.8	91	131
India.....	rupees	68,900	4.70	14,659.6	34	112
Iran.....	rials	NA	31.4			
Israel.....	pound	412	1.85	222.7	105	151
Jordan.....		NA	.293			70
Pakistan....	rupees	15,900	4.70	3,383.0	35	97
Turkey.....	T. Lira	19,544	6.15	3,177.9	114	117
Far East						
Japan.....	yen	1,778,600	308.5	5,765.3	62	117
Philippines	pesos	3,523	3.61	975.9	35	121
Taiwan.....	N.T. Dollar	17,387	41.4	420.0	40	111
Thailand....	baht	20,652	19.4	1,064.5	41	112
Africa						
Nigeria.....		NA	.318			90
Sudan.....	pound	202.2	.444	897.8	76	154
Tanganyika..	pound	109.5	.322	352.6	38	138
Tunisia.....						97

Sources: Column 1: U.N. Yearbook of National Accounts, 1963; except for United Arab Republic, Agricultural Economics, Agricultural Economics and Statistics Department, June 1962, p. 12. All values were given at 1960 prices except Venezuela at 1957 prices, 1,807 million pesos, and Mexico at 1950 prices, 14,018 million pesos. Output at 1960 prices was obtained by applying the general wholesale price indices to the values given. The price indices are from U.N. Statistical Yearbook, 1962. Column 2: U.N. Yearbook of National Accounts, 1963. The rates are an average of 1958 and 1962 rates, except Tunisia and Spain at 1958 rates. For Poland and Yugoslavia foreign exchange rates were used in the absence of parity exchange rates. Column 3: Column 1 divided by column 2. Column 4: Column 3 divided by 1960 population. Column 5: Column 1, table 1, divided by column 2, table 1.

Table 81.--Agricultural exports and imports, 26 study countries

Country and area	Agricultural exports per capita of total population		Agricultural imports per capita of total population		Net agricultural trade balance per capita per year, 1959-61
	Total amount per year, 1959-61	1960 as a percentage of 1950	Total amount per year, 1959-61	1960 as a percentage of 1950	
	Dollars	Percent	Dollars	Percent	Dollars
Latin America					
Argentina	48.52	165	3.71	808	44.81
Brazil	15.54	71	2.91	62	12.63
Chile	1.98	76	9.33	80	-7.35
Colombia	25.55	84	4.33	100	21.22
Costa Rica	67.81	97	15.71	165	52.10
Mexico	14.11	179	2.17	71	11.94
Venezuela	4.47	76	26.73	354	-22.26
Europe					
Poland	6.82		13.13		-6.31
Spain	11.96	163	8.17	174	3.79
Yugoslavia	10.52	295	11.37	147	-0.85
Near East & South Asia					
Egypt	15.23	92	7.24	94	7.99
Greece	20.81	172	13.57	178	7.24
India	1.40	131	1.22	104	0.18
Iran	0.72	300	0.41	228	0.31
Israel	35.76	1,353	54.64	602	-18.88
Jordan	4.01	140	25.92	295	-21.91
Pakistan	2.71	72	1.23	455	1.48
Turkey	11.03	93	2.45	147	8.58
Far East					
Japan	3.97	245	18.71	135	-14.74
Philippines	12.04	101	4.05	114	7.99
Taiwan	11.38	85	6.13	136	5.25
Thailand	13.32	158	1.91	372	11.41
Africa					
Nigeria	11.14	114	2.29	224	8.85
Sudan	14.89	126	4.97	151	9.92
Tanganyika	12.35	442	0.94	237	11.41
Tunisia	18.76	166	9.29	165	9.47

Sources: Tables 1 and 2.

Table 82.--Changes in field crop area and output, 1950 to 1960 (1960 as percent of 1950)·

Country and area	Area	Quantity	Country and area	Area	Quantity
Latin America			Far East		
Agrentina	125	141	Malaysia		
Brazil	140	147	Malaya		
Chile	117	139	Singapore		
Colombia			Philippines	162	165
Costa Rica			Taiwan	109	148
Mexico	131	178	Thailand	119	147
Venezuela					
			Europe		
Near East & So. Asia			Poland	100	134
Egypt	105	122	Spain	102	127
Greece	117	157	Yugoslavia		
India	121	142			
Iran	130	157			
Israel	179	409	Africa		
Jordan			Ghana		
Pakistan	108	113	Liberia		
Turkey	154	158	Nigeria		
			Sudan	151	232
Far East			Tanganyika	150	171
Japan	102	133	Tunisia	143	86
Korea (So.)					

Source: 1959-61 average divided by 1949-51 average.

Table 83.--Ratings of specified countries on selected aspects of their economic development foundations[1]

Country	Conditioning Factors				Production Factors			
	Land tenure	Farm prices	Markets	Consumer goods	Knowledge	Production requisites	Credit	Investments in land development
Latin America								
Argentina	2	2	2	1	2	1	2	2
Brazil	3	3	3	2	3	2	2	1
Chile	3	3	3	3	3	3	3	3
Colombia	2	3	3	2	3	3	1	3
Costa Rica	1	2	2	1	2	2	1	2
Mexico	1	1	1	2	2	1	2	2
Africa								
Nigeria	2	2	2	2	2	3	3	3
Sudan	3	3	2	3	1	3	1	1
Tanganyika	3	2	3	3	2	3	3	2
Tunisia	1	1	1	1	1	2	1	1
Near East and South Asia								
Egypt	1	1	1	2	3	2	1	1
India	2	3	3	3	3	2	2	2
Iran	--	--	--	--	--	--	--	--
Jordan	1	3	3	1	2	1	2	3
Pakistan	2	2	3	3	2	3	2	1
Turkey	2	2	2	2	2	3	1	3
Far East								
Philippines	2	3	3	2	2	2	3	1
Taiwan	1	2	1	1	1	1	1	1
Thailand	1	3	2	1	3	2	2	1

[1] The ratings of 1, 2, and 3 mean favorable, moderately favorable and unfavorable, respectively. These ratings have been made by AID Missions for their respective countries.

Source: Questionnaire replies by U.S. AID Mission in reporting countries.